A BEHAVIOUR MODIFICATION INTERVENTION TO INCREASE THE NUMBER OF STUDENT CYCLISTS USING CYCLE LIGHTS AT NIGHT.

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ABSTRACT

The failure of over half the cycling population of Christchurch to use adequate head and tail lights when cycling at night has continued to be of considerable concern. A behaviour modification campaign promoting the use of cycle lights was implemented at the two main tertiary institutions in Christchurch, using a multiple baseline design. The City Centre served as a control, receiving no experimental manipulation during the eight-week study. The design was based on a similar study carried out eight years prior (Ferguson, 1987). Ferguson's study failed to achieve the desired result of increasing the proportion of student cyclists using cycle lights at night. Modifications suggested by Ferguson were the basis for the current study.

Following a brief baseline period, a multimedia prompting condition was introduced at both experimental locations with the aim of increasing awareness of the dangers associated with cycling at night without lights, and to encourage students to purchase lights. An incentive component was then initiated enabling students to purchase lights at the campus book shops, and giving them the opportunity to win back the purchase price of their lights. Finally an enforcement campaign was imposed with the Ministry of Transport stopping and fining those cyclists without adequate lighting. Overall, the intervention campaign proved as ineffective in significantly increasing the proportion of cyclists using head and tail lights when cycling at night. Despite students gaining a greater awareness of the cycle light issue, improvements in the observed behaviour were not demonstrated, and were not maintained over the duration of the campaign. Reasons for the ineffectiveness of the campaign, and possible directions for future research in this area are discussed.

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INTRODUCTION

Road traffic in the city of Christchurch, New Zealand, has a greater proportion of cyclists that in most other New Zealand cities. Seventy five percent of school students cycle to school and 11% of the work force cycle to work (Gadd, Huntington and Cambridge, 1992). Large numbers of cyclists using the roads have resulted in a correspondingly large number of cycling accidents, again proportionally higher than in other New Zealand cities (Cambridge, 1992). Cyclists were involved in 17.6 % of reported traffic collisions in Christchurch during 1991 (Gadd et al., 1992). According to Accident Compensation Corporation Injury Statistics, there were 17 fatal and 3458 non-fatal new claims made resulting from cycle accidents in Christchurch in 1992. The Christchurch City Council Traffic Operations Unit Technical Services Group Collision Analysis for 1992 recorded a total of 202 collisions involving cyclists, with a total estimated collision cost of $14,684,000.

Recent research has established that the injuries resulting from these collisions are more severe for cyclists than for other road users. The fatality rate for cyclists is even higher than that for motorcyclists (McDermott and Klug, 1985). In a study of collisions between cyclists and motorists in New Zealand, Atkinson and Hurst (1983) determined that cyclists were twice as likely as motorcyclists and fifty five times more likely than motorists to suffer injury. The Christchurch Cycle Safety Committee Report (1991) estimated that cyclists may be 12 times more likely to be involved in an injury collision per kilometre travelled than motor vehicles.

The majority of accidents studied by Atkinson and Hurst (1983) were caused either as a result of cyclist errors or by motorists not seeing the cyclist at night. This suggests a lack of visibility of cyclists on our roads at night. This is corroborated by the Christchurch Cycle Safety Committee (1991), who state that the main factor contributing to adult cyclists' collisions is not being seen in time. For school children cyclists it was found to be loss of control.

A study undertaken by Atkinson and Hurst (1984) found that the highest proportion (40%) of fatalities in cycling collisions for the previous year (1983) involved motorists overtaking cyclists. The main causal factor stated was the motorist simply not seeing the cyclist at night. One other factor that has been suggested in motorist/cyclist collisions was inattention or failure to look, on the part of both motorists and cyclists (Atkinson & Hurst 1983).

Although the majority of collisions between cyclists and motor vehicles occur under daylight conditions, the risk of having a fatal collision is nearly four times greater under conditions of darkness (Noordzji, 1976). Another study demonstrating a clear over involvement of bike fatalities at night is Hoque's (1990) Australian study of fatal bicycle accidents during 1981-1984 in Victoria. Nearly a third of the fatal bicycle accidents was accounted for by two situations: motorists overtaking and failing to detect the cyclist; and cyclists swerving unexpectedly. Hoque found that approximately 60% of the cyclists involved in fatal accidents at night did not have any lights on their bicycles. In 90% of the night time fatalities the cyclist was hit from the rear, however, this only occurred with 40% of the cyclists during the day time. To Hoque, this clearly demonstrated a problem of lack of visibility of cycles at night. Recommendations were made by Hoque to improve the visibility of cycles by ensuring that cycles are equipped with lights and/or reflective materials. It was also suggested that the adequacy of existing bicycle lighting devices be examined.

Gadd et al. (1992) found that cyclists were over-represented in overtaking collisions, right turn against traffic collisions, right angle collisions, entering a traffic stream and leaving a stream. The passing or overtaking type collision is one in which the cyclist is significantly over represented. Where 17.6% of all collisions involve cyclists, 58% of passing collisions involve cyclists.

The above statistics demonstrate:

i) the high prevalence of cyclist collisions,

ii) the majority tend to be severe,

iii) they are costly to the local economy, and

iv) the main causal factor involved appears to be lack of visibility of the cyclist.

Conspicuity

Visual conspicuity refers to the ability of an object to attract attention and to be easily located due to its physical properties According to Wulf, Hancock & Rahimi (1989) "*visual conspicuity as it is usually understood refers to the*

ability of an object to attract attention and to be easily located due to its physical properties " (p. 157).
In other words, it is the meaning an object has for an observer, based on their level of interest and experience. Conspicuity in relation to cyclists is a relatively new field, however, a considerable amount of research has been conducted in the area of motorcycle conspicuity.

Motorcycle Frontal Conspicuity

Night time conspicuity of motorcyclists has been demonstrated to be significantly improved when a motorcyclist uses additional running lights (such as the turn signals being used as running lights) or if they are wearing a retroflective vest and helmet cover (Olson, Halstead-Nussloch & Silak, 1981). Given that about three out of four motorcyclist accidents occur in day time, one major conclusion drawn from the above study is that the most effective means of improving day time conspicuity (considering performance, cost, and cyclist convenience) is to require motorcyclists to drive during the day with their low-beam headlamp turned on. Thompson (1980) of the Traffic Research Section of the Ministry of Transport New Zealand, concluded that compulsory usage of motorcycle headlights should be favoured.

Motorcycles and bicycles offer much less protection to their riders than do automobiles. As a result, when a collision occurs, cyclists are far more likely to suffer injury than motorists. According to Muller (1984), studies of motorcyclist accidents have shown that the most frequent type of crash involves a collision with an car at an urban intersection in daylight. Car drivers are most often at fault for the collision and frequently claim that the motorcyclist could not be seen. Williams and Hoffmann (1979) found also that the main problem was that of motorists simply not seeing motorcycles, or seeing them too late to avoid a collision. Williams and Hoffmann found that the conspicuity of the front of the motorcycle was vitally important.

Ramsey & Brinkley (1977) evaluated visual signal warning devices commercially available to improve the noticeability of motorcycles and riders during daylight conditions. The sorts of active lighting systems analysed included revolving lights, prisms reflectors and strobes. The results indicated that small, low intensity devices were of no value in improving conspicuity however, larger, higher intensity devices had the potential to increase conspicuity by 300%.

Olsen (1989) reviewing a number of studies reported positive results of day time headlight use in reducing day time multi-vehicle collisions. Olsen states however, that the support these investigations offer for the conspicuity hypothesis is indirect at best. "It is necessary to assume that conspicuity must be a problem for motorcycles; otherwise doing something that makes them more conspicuous would not reduce collisions." (pg 143). However, Muller (1984) is only prepared to state that day time headlight operation *may* be beneficial in reducing the number of motorcycle fatalities. Olsen (1989) indicates that a change in motorcycle crash frequency associated with the use of headlamps during the day does not provide support for the conspicuity hypothesis. It may merely demonstrate that all vehicles can be aided in this way. Cercarelli, Arnold, Rosman, Sleet and Thornett (1992) compared drivers who had been in collisions with vehicles which had small and large frontal profiles (motorcycles/cars) and found that car drivers have similar difficulty in detecting both. Olsen's (1989) research supports this as he noted that cars and motorcycles are involved in the same kinds of collisions with about the same relative frequency, with the exception of the category in which one vehicle turns across the path of an oncoming vehicle. Such crashes were more likely to involve a motorcycle and a car than two cars.

Other Factors Which Influence Cyclists Visibility To Drivers

As lights on cycles are of considerably less power than those of a motorbike, operating lights during daylight would be of little value to cyclists. Hoque (1990) has also demonstrated that the area most vulnerable to cyclists is the rear. Means available to improve conspicuity therefore include fluorescent and retroreflective garments and accessories, as these have been shown to increase both motorcycle/motorcyclist conspicuity. They work better however, when worn by the rider than when fitted to the bike (Olson et al., 1981), possibly because this raises their height above the road.

It has been repeatedly shown that retroreflective materials are highly visible from distances far greater than those necessary for stopping when driving at most speeds

(Shinar, 1984). The level of reflectance of even a small badge of retroflective material was sufficient to increase visibility to a safe stopping distance, however there is the necessity to inform the driver that the reflective light is from an object on the road rather than off the road. The use of a visibility aid such as a fluorescent tag has been suggested both by Olsen et al., (1981) and Shinar (1984). Shinar suggested that a standardized, easily recognisable tag that could be readily attached to or detached from clothing would be ideal. It is suggested that the effectiveness of such aids would be further increased if they were consistent with the population's stereotypes of pedestrians and bicycles. Shinar however expressed concerns that as long as drivers were not aware that the presence of such a tag meant that it was attached to a pedestrian or cyclist, there was a danger that their use would lull pedestrians and cyclists into putting themselves into vulnerable positions due to them feeling too secure in their high visibility. Reinhardt-Rutland (1986) expressed the opposite concern, that while such a tag might have an effect on drivers behaviour initially, because it is unexpected, the effect may dissipate with increase familiarity.

Thompson (1980) reported on a number of variables which can influence the detection of objects. The position that an object occupies in the field of view of an observer has considerable bearing on the probability of its detection. Accidents involving motorcycles viewed in the peripheral area of the motorist's visual field were found to be more common than when motorcyclists were in the driver's central visual field. In daylight conditions, visual acuity is considerably less sensitive near the periphery. According to Wulf, et al., (1989), detection typically takes place in the periphery of the retina, and an eye saccade is then triggered to examine the object more thoroughly in the fovea. The probability of an object being detected and receiving foveal attention is comparatively high for more conspicuous objects. Wynne-Jones (1981) states that even with the difficulty of motorcyclists appearing in the motorists peripheral vision, or when the motorist is concentrating on other things happening at the time, with motorcyclists using day time headlights, it is almost always possible to see the oncoming motorcyclist.

Thompson (1980) suggests that there are a number of physiological and psychological reasons for non-conspicuity of an object such as size, luminance contrast, position in the driver's field of vision, and other factors such as alcohol, the ability to perceive a relevant object and ignore others (field independence-dependence). Psychological variables such as expectancy and detection criterion are important variables which affect visibility. When the driver expectancy is high or where road users become adapted to respond to these visual cues provided by the larger vehicles which they encounter most often, they find it difficult to notice motorcycles and cyclists which are both smaller and less common (Wynne-Jones, 1981). The results of Shinar (1985) are consistent with previous findings in that they demonstrate the slight visibility detection benefits of light clothing over dark clothing and the large benefit of retroreflective tags over both. It was found that visibility distance for an expected obstacle on the road can be up to twice as far as that for an unexpected object. He states that the psychological variable of expectancy can be more potent than physical variances such as illumination, and reflectance.

The lack of experience of some drivers in dealing with vehicles such as motorcycles may reduce "cognitive conspicuity". Other factors leading to accidents due to information processing failures include alcohol, fatigue, inattention and information overload (Wulf et al., 1989).

Other hypotheses which have been put forward to account for motorcyclist's collisions with motorists and which have a strong relevance to cyclists include:

i) Occlusions, where a driver's view of another vehicle can sometimes be blocked by a variety of objects. Because motorcycles (and cycles) are much smaller than most other vehicles (particularly when viewed from the front), they are more likely to be occluded (Olsen,1989).

ii) Distance Judgement Errors: because apparent size is an important cue to distance, there is the possibility that drivers may overestimate the distance to an approaching motorcycle (and cycles). If motorcycles tend to be judged farther away, this would increase the likelihood that another vehicle would intrude into their path, when the gap is in fact, too small.

iii) Speed Judgement Errors: Olsen (1989) suggests that motorists have more problems judging the speed of approaching motorcycles (and cycles) than cars. Wulf et al., (1989) expresses concern at findings that the estimated speed of a motorcycle with headlights off is actually higher than a motorcycle with its headlight on. This effect apparently counteracts the conspicuity enhancing effects of daylight use of headlights by motorcyclists. Even though speed estimation is similarly accurate for trucks, cars and motorcycles, it has been found that the gap size accepted for motorcycles is significantly smaller than those accepted for other vehicles. Car drivers seem to apply different standards when interacting with motorcycles compared to other vehicles (Olsen, 1989; Wulf et al, 1989).

Rear Reflectors

Collins (1988) in his study on bicycle lighting use in the city of Palmerston North, New Zealand, found that many of the rear reflectors fitted to bicycles were of such poor design or were placed in such a way to be virtually useless for night time visibility from the rear. While 37% of bicycles in his study did not meet the legal requirements of having a rear reflector, as well, a higher percentage would not have had an *effective* rear reflector. The Road Code (1986) which provides the legal requirements for reflectors, requires either a strip of red reflective tape 50 mm x 50 mm, or a white patch 75 mm x 75 mm and a red rear reflector.

The important factor in detection of an object according to Watts (1984) is reflective power, with size, shape and colour only having a small effect. He also determined that the visibility of a reflector is dependent on the amount of light received from headlights of the on-coming car. Atkinson and Hurst (1983) expressed a similar concern that to be of any use, reflectors must be illuminated by a motorist's headlights long enough for the motorist to change their course. In the normal course of events this only occurs when a motorist is approaching a cyclist directly from behind.

Collins (1989) states that pedal reflectors have been found to be the most effective form of reflector due to their movement attracting the attention of other road users, and because they do not become wrongly positioned or obscured by the cyclists clothing or luggage. Since January 1st 1988, it has been compulsory for new bicycles to be fitted with pedal reflectors. Watts (1984) determined that pedal reflectors and a reflective jacket significantly improved that distance at which a cyclist could be recognised and stated that it should improve judgement of the distance between the cyclist and the motorist. Reflective jackets have the distinct advantage of being effective from all angles, not just from directly behind.

Head Lights and Tail Lights

Noordzij (1976) suggested fatal bicycle accidents in the dark were related to the perceptibility of the rear of the cycle. Measures he recommended to alleviate this problem were to have more cyclists using their rear lights, the use of more reliable rear lights or large red reflectors on the bicycles. Hoque (1990) found that in 90% of night time cyclist fatalities, the cyclist was hit from the rear, compared with 40% in day time. Hoque also found that inadequacy of bicycle and street lighting was an important factor in night time fatalities.

Ferguson and Blampied (1991) concluded that cycling at night is dangerous, especially if the cycle does not have lights. Atkinson and Hurst (1984) found that up to two thirds of fatal accidents happened to cyclists who had no rear lights. They state that requiring adequate tail lights and/or reflectors seemed the most obvious cost-effective means of reducing serious and fatal collisions. The ease of this measure affords it the greatest potential for reducing fatalities. New Zealand legislation specifies that all cycles at night must have a white front headlight and a rear light, both of which must be visible from 100 metres (Road Code 1986).

The problems of cyclists not being seen are not restricted to night time. Atkinson and Hurst's (1984) study found that 60% of fatal accidents occurred during daylight hours. The vast majority of bicycle crashes in Begg, Langley and Chalmers' (1991) study occurred during daylight hours, from mid afternoon to early evening, in fine weather conditions. The Christchurch Cycle Safety Committee (1991) Report states that in Christchurch there is no evidence to suggest that it is more dangerous to ride a cycle in darkness than in daylight. They found that the proportion of collisions in the dark was lower for cyclists than for other road users.

Altering Perception

Altering people's perception involves changing the environment in an attempt to alter perception and subsequent behaviour. Attempts have been made to decrease the delay in reaction time between perception of problems in the environment and reaction by the operator of the vehicle. Using such things as road markings, vehicle signal lights and improved lighting of roads, increases the perception of the change in the environment. Robertson (1983) found that placing an additional rear brake light in the centre of the rear of the car above the trunk lid resulted in a 50% reduction in rear end collisions. Other patterns such as higher brake lights to the side do not have the same effect. This suggests that it is perceptual enhancement rather than the novelty of the brake lights that produces the reduced crash rate.

Education

Hoque (1990) determined that cyclists perceive collision danger from the rear as being high, however, their estimation of danger is considerably lower than the actual rate of night time fatal accidents from the rear. This lack of correct estimation of night time accident risk by cyclists suggests a need to educate cyclists as to the actual risks they face in night time cycling so that they can take appropriate action for their safety.

Robertson (1983) demonstrates that persons skilled in a hazardous endeavour are less likely to be injured than those less skilled. He states that providing education is one way of attempting to increase skill levels. However, the information must be retained, and educators must have the means available to teach the information and skills and cause behaviour change related to emotions, attitudes and values. Care also needs to be taken that training does not increase the tendency to be overly confident in driving ability.

A number of educational studies have been undertaken in the road safety field directly relevant to cyclists. Some of these are outlined below. Atkinson and Hurst (1983) suggested that education is needed in the proper choice of lane, and positioning within lanes. Recently, both of these have been a focus for the Ministry of Transport, emphasised through both education and considerable publicity, using a variety of media. However, no evaluations have been undertaken to determine the success this and similar campaigns. Robinson (1983) stresses the importance of trialing and evaluating programmes on a small scale before considering applying them to the population at large.

Begg et al., (1991) suggested the use of road safety awareness programmes as a means to demonstrate the necessity for cyclists to take special care with regards to other road users. The Ministry of Transport have bicycle safety resource materials available for both school and community groups. Again, evaluations of such programmes are required in order to demonstrate the most effective ways of improving cycling safety and reducing the problem of injuries to cyclists. Other measures suggested by Begg et al. to prevent injuries include education on the importance of “vigilance when riding on the road” (p. 61) and regular maintenance checks to ensure that the bicycle is of the required standard for riding on the road.

Rainbird, Briggs and Quimby (1985; in Brown, 1985) found that in at least 30% of day time road accidents attributable to human error, there is evidence of perceptual difficulty. Brown therefore suggests training in hazard perception.

Langley, Silva and Williams (1987) state that while education is one of the obvious prevention strategies, more attention needs to be given to other strategies such as compulsory lighting, improvement of lighting standards and the separation in space or time of cyclists from motor vehicles. They suggest that only through a mix of counter-measures will a reduction in injuries be achieved.

Behaviour Modification

The principles of behaviour modification by manipulating rewards and punishment have been pursued for decades by experimental psychologists (Robertson 1983). In the laboratory, and in settings such as school classes, hospital wards, work places and families, people do modify their behaviour in response to reward or punishment contingencies. Controlling such contingencies for a large population, however is another matter in that there are major interpersonal variations as to what is perceived as rewarding and what is punishing.

Robinson (1983) found that using rewards for seat belt use increased their use when the rewards were sustained, but the effect did not last when the rewards were removed. These rewards do not have to be large, but they do need to continue indefinitely. Other difficulties found were the need for large numbers of observers to identify those eligible for the rewards, and for those rewarded, to be done so publicly. This makes it much easier to use rewards and punishment in industry than among the public at large.

Enforcement

According to Robinson (1983), perception of increased enforcement has some temporary effect, but if the actual enforcement is not increased to apprehend and convict more than 30% of the violators, the effect is temporary. Langley and Williams (1992) found that the cyclists in their study tended to consider the chances of being apprehended by a traffic officer for failure to use a tail-light at night as being low. There is resistance to compliance with laws that result in discomfort, inconvenience and cost (Robinson 1983).

Brown (1985) debated whether or not it is better to design effective publicity campaigns which change road users' attitudes towards specific safety problems (leading eventually to the desired behavioural change), or if is it is more efficient to change traffic laws and enforce changes in road user behaviour, in the hope that attitudes towards the problem in question will eventually be reshaped. He suggests that the later approach may be necessary and can be highly effective on occasions. Robertson (1983) states that legislation requiring the use of protective equipment can be remarkably effective in gaining compliance depending upon the ease of observation of the behaviour by the enforcement personnel. The effectiveness however depends very much on the public's awareness of the law.

Joanah and Grant (1985) showed that periodic use of selective traffic enforcement programmes were effective in producing long term increases in seat belt use. A clear correlation between seat belt use and a consequent reduction in traffic accident casualties was also demonstrated. Williams, Lund, Preusser, and Blomberg, (1987) in their study of a seat belt use law enforcement and publicity campaign found that enforcement/publicity programmes were an important and feasible method for increasing compliance with seat belt use.

Beaglehole (1990) suggested that educational or enforcement programmes alone are incapable of solving health problems. He noted that in the traffic safety field, undue emphasis has been given to driver behaviour modification through educational and punitive measures. Collins' (1989) survey of the use of cycle lights in Palmerston North, demonstrated the inadequacies of using only enforcement. The purpose of the survey was an attempt to determine the reasons for poor compliance with legal and safety requirements after previous studies had determined that 64% of cyclists riding at night did not display the required front and rear lights. It was hoped that the results would indicate the most useful directions for future cyclist education and enforcement efforts. It appears that the high level of non-conformance with the bicycle lighting regulations was not in the majority of cases due to the ignorance of the law, or to financial constraints. In most cases the offending cyclists did not feel the need to comply with the regulations and were unaware of, or were unconcerned about the risk of accidents occurring.

Incentives

Wilde (1991) demonstrated that incentives for accident-free driving had a strong motivating effect on members of the driving population, thereby reducing accident rates. They found it necessary to ensure that incentives were made contingent upon accident-free performance rather than upon some specific behaviour that may or may not lead to greater safety. They were concerned that that while the rewarded behaviour may improve, other related safe behaviours may deteriorate.

Roberts and Fanurik (1986) demonstrated that even children can become responsible for their own health behaviour. They rewarded elementary school children for the use of car seat belts. The children increased both their own seat-belt use and that of their adult drivers and other passengers. Incentives achieved their greatest impact during the first few days. It was found that intermittent schedules may produce a greater generalization across time due to unpredictability of reinforcement. The use of booster sessions of rewards was suggested.

Hagenzieker (1991) in his study promoting safety belt use among military personnel in the Netherlands, found both incentives and enforcement effective in promoting safety belt use. He found that legislation alone was not sufficient to achieve universal use of vehicle safety belts. Young males tended to use their safety belts less often than other groups. Other studies have demonstrated that campaigns consisting of enforcement and publicity can increase safety belt use rates substantially. The problem with the use of only incentives is that rates typically decrease within a few weeks of the withdrawal of the incentive. In the above study, the enforcement programme led to greater overall increases in belt use than did the incentive programme. It was concluded that enforcement enhances safety belt use substantially if the enforcement is actually carried out.

Ludwig and Geller (1991) used a multiple baseline design where a number of different treatments were individually introduced and removed in an attempt to improve the driving practices of pizza deliverers. The use of seat belts and turn signals were targeted. It involved education, feedback, signing a personal commitment card to buckle-up, and employee designed buckle-up reminder signs. The use of safety belts increased 143% and turn signals 25%. Younger drivers (under 25 yrs) were markedly more influenced by the intervention than were older drivers. Some drivers may require more effective and costly intervention programs to motivate their safe driving practices.

Mass Media

According to Robertson (1983) when trying to change everyday behaviours, frequent reminders seem to have some effect. In the 1970s studies were conducted to measure the effect of mass media campaigns on seat belt use in cars. This research raises serious doubts that a media campaign can be devised that will have a major impact in any change of daily behaviour that involves even a slight inconvenience.

Posters aimed at a specific safety related act that are prominently placed at work sites where the behaviour is relevant have been found to have an effect (Robertson, 1983).

Sign Posting

Yu and Martin (1987) found that educational sign prompting to be an effective, low cost procedure for influencing golfers on a public golf course to decrease the number of unrepaired ball marks on putting greens. Education in how to perform the desired task is essential. Modeling and seeking approval from other golfers may also have had an effect.

Van Houten and Nau (1981) used posted feedback and increased police surveillance to reduce highway speeding. They found that although public posting was highly effective in reducing the percentage of speeding drivers, increased public surveillance was not. Public posting is much more efficient in time and money to maintain. Using a concealed police unmarked car may have been more effective in reducing speeds. Having a highly visible patrol car was very effective in reducing speeds, but only on the particular street it was situated. There was no overlapping effect onto neighbouring streets.

Sherer, Friedmann, Rolider and Van Houten (1984) undertook a saturation enforcement campaign on speeding in Haifa, Israel. An enforcement package and a reinforcement programme were employed. The enforcement package included feedback signs and stopping vehicles when speeding was detected during random allocated times. Feedback given included official looking fliers describing the number and type of accidents which had occurred on that particular street during the past year. The number of fatal accidents which had occurred on that street for the previous year were also prominently displayed. Drivers, when stopped, were given a warning ticket that became a speeding charge if a computer search showed the person had either been warned or charged during the preceding year. Police were present for 1.5 hrs per day for the first 4 days, then their presence was gradually removed over the following weeks. The reinforcement program involved stopping those travelling within the speed limit and presenting them with a thank you certificate from the police chief, and an engraved pen. The introduction of the enforcement program reduced serious speeding by 64% and reduced accidents (63%) and injuries (67%). The study demonstrated that a psychological approach to speed limit enforcement in urban areas can be highly effective when applied on a wide scale. The effects of the study lasted for 6 months.

Beaglehouse (1990) suggests that the appropriate strategies to reduce the number of road deaths involve a combination of educational, engineering, enforcement, environmental and legislative measures. Malenfant and Van Houten (1988) produced clear increases in the percentage of motorists yielding to pedestrians and in the percentage of pedestrians signalling their intention to cross at crosswallks after their intervention consisting of engineering devices, police enforcement, education and media attention. The interventions were relatively inexpensive and well received by the public, media and the government. Collins (1989) also agreed with a multifaceted approach to cycle safety suggesting the following:

- more extensive education of school pupils and their parents on the dangers of cyclists not being adequately visible at night.
- publicity campaigns on TV and newspapers, although the effect of these seems to be short lived.
- requiring cycle retailers to sell lights with every new bike
-Instituting a "warrant of fitness" scheme for bicycles
- A greater degree of warning and enforcement activity by Traffic Officers at night.

Helmets

The use of bicycle helmets according to Hoque (1990), has considerable potential in reducing fatalities and injuries. Begg et al. (1991) found that the body region affected in 75% of cycle accident cases were the limbs, the rest being head injuries. The proportion of head injuries increased however, when the more serious injury crashes were examined. McDermott and Klug (1985), when examining pedal and motorcyclist casualties in Victoria, found that pedal cyclists sustained significantly more frequent and severe head injury. These differences may be partly explained by the fact that virtually all of the motorcyclists were wearing helmets, compared to only a few of the cyclists.

These findings emphasise Begg et al.'s (1991) claim that the most obvious way to reduce the incidence and severity of head injury is to wear bicycle safety helmets. They demonstrated that the wearing of helmets reduced the risk of head injury by 85% and brain injury by 88%. Overall, The use of safety helmets has the potential to prevent 26% of reported injuries.

Christchurch is well above the national average for helmet wearing, and has one of the best helmet wearing rates in New Zealand. The wearing of cycle helmets has been monitored by the City Council twice yearly since 1989. In March 1992, the wearing rates were 50% for adults, 87% for secondary students and 73% for primary school students. It will be compulsory for cyclists to wear helmets from January 1st 1994 (Christchurch Mail, 7.6.93).

Cycle Collision Statistics

Collecting accurate statistics on the number and type of injuries is complicated by the fact that large discrepancies exist between the number of patients admitted to hospital for injuries resulting from a road traffic crash and the official Ministry of Transport road traffic crash statistics (Begg, Langley & Chalmers, 1990; Begg, Langley & Chalmers, 1991). Under reporting of road traffic crashes to the Ministry of Transport was shown to be an important factor in these discrepancies. The Ministry of Transport's data base only includes crashes that involved a motor vehicle and resulted in injury. Bicycle-only crashes, where the cyclist hits either the road or other objects but not other vehicles and where the cyclist is the only injured party, are excluded. Collisions recorded in a medical survey (information drawn from general practitioners and the Emergency Department at Christchurch Hospital) in the Christchurch Cycle Safety Committee (1991) report were compared with those reported to the Ministry of Transport over the same period of time. From this data it was estimated that the reporting rate for all cycle collisions resulting in injury was only 21%. Better information on cyclist collisions is becoming available with the addition of data on road traffic collisions from the Emergency Department at Christchurch Hospital (Gadd, Huntington and Cambridge, 1992). The Christchurch Cycle Safety Committee (1991) report recommended the need to improve systems for collecting information and for education and publicity for both cyclists and motorists on cycle collisions. Combining data from the Emergency Department at Christchurch Hospital with Ministry of Transport records should produce a more accurate picture (Gadd, Huntington and Cambridge, 1992).

The Present Study

The main purpose of this present research is to further research carried out by Ferguson (1987) on increasing the use of bicycle lights by student cyclists. This study found that at most, adequate lighting was used by only about 50% of cyclists. A hypothesis was put forward that there were two types of cyclists: "fair weather cyclists" (Ferguson and Blampied, 1991, pg 568) who typically ride in the late afternoon/early evening, use alternative transport when wet and who do not ride long distances, and committed cyclists- those riding later at night and in all weathers. The committed group tend to have higher levels of cycle equipment, including lights and helmets. The less committed group may ride less often, may be less experienced and are less well equipped, ride in the early evening when traffic densities are higher, and are therefore exposed to more risks. The present study attempted to measure this by the use of a Cycle Safety Awarness Evaluation Questionnaire.

Ferguson's (1987) research showed that cycle-light use was sensitive to naturally occurring variables such as weather and sunset. Sunset time was particularly significant. Because of possible bias due to increasing levels of light, the current study was carried out during the darkest periods of winter.

It was thought that the most critical factor in the lack of success of Ferguson's (1987) study was the failure of the incentive condition to produce any positive changes. He suggested that any replications of this study must make the incentive procedures more effective. It was suggested that the emphasis needs to be on the critical step of purchasing and fitting lights rather than using them. The present study enabled students to purchase lights at a good price from their campus bookshops. This made them readily available and affordable. A combination of behavioural and legal measures was also suggested, particularly the use of enforcement for those who fail to comply with the legal requirements. One of the interventions of this current study involved the Ministry of Transport stopping cyclists without lights.

A similar intervention package to the one used by Ferguson (1987) was used in this present study. It incorporated prompting, an incentive competition and enforcement phases. The two main educational institutions in Christchurch, New Zealand were selected as locations according to a multiple baseline design. In order to control for any extraneous variation in the use of cycle lights, a third location of the City Centre was also selected.

As with Ferguson's (1987) study the main hypothesis behind this present study is that by introducing the cycle light campaign, the proportion of night time cyclists using adequate lighting would increase significantly. Another hypothesis was that the intervention would result in a greater awareness of the dangers associated with not using adequate lighting when cycling at night.

METHOD

Setting

Cyclists were observed at night in three locations around Christchurch city. The locations were:

University of Canterbury: The University is located 6 km from the city centre, was attended in 1991 by 10419 students (76% full-time) and 1200 staff. Lectures and Laboratories run until 9.00pm, and the libraries are open until 11.00pm. The university is well equipped for cyclists with easy access provided. Cyclists were observed from the four main University exits: corner Clyde Rd and Kirkwood Ave, corner Kirkwood Ave and Ilam Rd, corner Ilam and Creyke Rds and corner Clyde and Creyke Rds (see appendix 1. for maps of each location).

Christchurch Polytechnic: The Polytechnic is located at the edge of the central business district, however access is more difficult as it is situated between two of Christchurch's heavily used one-way streets. Polytechnic was attended by 1700 students (85% part-time) and 500 staff. A large majority of the classes are held in the evening, with the final lectures finishing at 9pm. The three exits used as observation sites were located at: corner Allen and Madras Sts, corner Williams and Coventry Sts, and corner Moorhouse Ave and Madras Sts.

Christchurch City Centre: Four of the main traffic routes out of the central city, around a 2 km radius from Christchurch's Cathedral Square, were were selected as sites. These included: corner Moorhouse Ave and Colombo St, corner Armagh St and Rolleston Ave, corner Bealey Ave and Victoria St, corner Fitzgerald Ave and Worchester St.

Observation procedures

The middle 39 working-days of the winter term were selected as the observation days, during the 8 weeks from 27th May 1991 to 19th July 1991. This was the darkest period of the year, where sunset times were the earliest. The study needed to be terminated once the sunset time began to increase as this was shown to be a biasing factor in Ferguson and Blampied's (1991) study.

University observations ran from Monday to Thursday, with the observations being grouped into two time slots: 5 - 6pm being early evening, and 6 - 7pm late evening. On different evenings, an observer returned once a week from 7.30 - 8.30pm to observe late night cyclists. (As the absolute numbers of this category was so low, this data was later collapsed with the 6-7pm observations.) The starting site was rotated each night. Ten minutes was spent observing at each site, and five minutes allocated to move to the next site. All four sites were therefore covered each hour.

The organisation of the City observations was the effectively the same as above, except observations were carried out only on Fridays. Twice an observer returned for the 7.30 - 8.30pm observation, on days 14 and 29 of the study.

At the Polytechnic, observations were again carried out Monday to Thursday. As there was only three sites, 15 minutes were spent at each site, with 5 minutes to move to the next. As some lectures finished at 7pm, observations carried on until 7.15pm. Again, one night a week, late observations from 7.30 - 8.30pm were carried out.

A single observer sat in a parked car near the exit, and for every cyclist that passed, marked a check-list noting the time, site, presence of head-light; tail-light; helmet; reflective gear on the bike (e.g., red reflector at rear of bike, peddle and spoke reflectors) and reflector gear on the cyclist's body (e.g., reflector tape, aprons, sashes and flashing lights connected to parts of their body) and whether the street lights were on or off (see appendix 2.). For reliability checks a second observer, on a different day each week, also recorded from the same vehicle. No communication occurred between them about the scoring, except to determine in which order the cyclists were to be recorded.

Materials

Posters: Fifty A3 sized posters were produced by the author for each of the campuses, stating that their respective bookshops would be selling lights, helmets and reflective gear for two weeks. Notification of a competition enabling students to win back the purchase price of their lights was also made. The bookshops were asked to be involved as Ferguson (1987) had hypothesized that students were more likely to buy lights if they were readily available on campus, rather than having to go to a bike shop to purchase them.

The second posters repeated the information that lights, reflective gear and helmets were able to be purchased, what their prices were, and that a competition was being run. However, they also warned that the Ministry of Transport that week would be enforcing the legal requirements to have both a front and rear light visible for 100 metres (appendix 3.).

Several posters promoting cycle safety, provided from ACC were also used at the Polytechnic and University. These mainly promoted the use of helmets and reflective gear.

Pamphlets: Two separate drops of 250 150 x 100mm pamphlets were made per campus. The front page of the pamphlets ran the slogan 'Wise up, Light up!". The reverse side stated the legal requirements for lights, that there was a possibility to win free lights, the prices of the equipment, where to purchase them, how long they would be available, and the supplier: Craig Adair Cycles (Appendix 4).

Promotion campaign

Based on the requirements of a multiple-baseline across settings design, intervention procedures began at Polytechnic, with a week difference before initiating phases at University. The full programme is outlined in Table 1.

Phase 1: Baseline - Baseline observations of cyclists began at each campus at the start of the middle academic term. They continued for 9 observational days at Polytechnic and 12 days at University. No promotional material was displayed at this time.

Phase 2: Prompting - This phase lasted 5 days at both campuses, and consisted of a multi-media approach to promote cycle safety. This included stating the legal requirements of the use of bike lights at night, promoting the dangers of not using them and advertising the imminent availability of lights, reflective gear and helmets at the campus bookshops. The media used included posters, pamphlets, articles in the campus newspapers (see appendix 5) and messages across the campus radio stations (see appendix 6).

Phase 3: Prompting and Incentive - The prompting phase continued, and the incentive phase began. The incentive phase consisted of offering students who bought lights, the opportunity to win back their purchase price. An ACC grant enabled $250 dollars to be allocated to each campus. With the cooperation of the bookshop staff, names and phone numbers of the purchaser was written on the back of the receipt for the lights. This receipt was then placed in a box, and at the end of each week, 12 names were drawn randomly. Names of the winners for that week were advertised outside the bookshop. Winners were then contacted and notified that they had won. Phase 3 also ran for 5 days at both campuses.

Table 1: **PROGRAMME OF INTERVENTION STRATEGIES**

Date		Sunset	Polytechnic	University
May	27	5.07	B	_
	28		B	_
	29		B	B
	30		B	B
	31	5.03	B	B
Public	Holiday			
June	4		B	B
	5		B	B
	6		B	B
	7		B	B
	10	4.59	P	B
	11		P	B
	12		P	B
	13		P	B
	14		P	B
	17		I	P
	18		I	P
	19		I	P
	20		I	P
	21		I	P
	24		E	I
	25		E	I
	26		E	I
	27		E	I
	28	5.00	E	I
July	1		M	E
	2		M	E
	3		M	E
	4		M	E
	5		M	E
	8		M	
	9		M	
	10	5.08	M	MTB
	11		M	
	12		M	_
	15		M	M
	16		M	M
	17		M	M
	18		M	M
	19	5.17	M	M

B = Baseline; P = Prompting; I = Incentive; E = Enforcement;
M = Maintenance; MTB = Mid-Term Break; **31** = City night only

Phase 4: Prompting, Incentive and Enforcement - This phase again ran for 5 days at each campus. Both the prompting and incentive phases remained the same. The enforcement phase consisted of a Ministry of Transport car on patrol throughout that week, stopping any cyclist who did not comply with the legal requirements. These requirements include having both a head and tail light visible from 100m and having lights turned on 30 minutes after sunset. Cyclists not complying with the legal requirements were given a $35 fine for each light. Those cyclists who had one of the two lights operational were able to have the fine waived if they were able to produce either a set of lights, or a receipt for them, the next day. Those with no lights were not generally given that option.

Phase 5: Maintenance - Observations of cyclists continued for 5 days at University (Mid-term break occurred in the middle of this period) and 10 days at Polytechnic.

Cycle Safety Awareness Evaluation Questionnaire

A total of 400 randomly selected cyclists (100 cyclists each from the university and polytechnic campuses, both before and after the interventions had taken place) were interviewed (see appendix 7). Subjects were approached from around the cycle stands, either entering or leaving the campuses. A pre-intervention questionnaire was administered to determine such information as what sort of protective gear the cyclist owned (lights, helmet, reflective gear), average distance and time they cycled, if they had seen anything encouraging the use of lights, their impressions of the importance of safety when cycling and their knowledge of the legal lighting requirements when cycling at night. The post-intervention questionnaire requested the same information, but also asked whether or not the cyclist had been aware of the competition enabling cyclists to win back the purchase price of their lights, and whether or not they had entered the competition.

Meteorological Variables

Four main meteorological variables were monitored over the duration of the campaign. Measures were taken from the Christchurch Meteorological Offices' readings recorded in the Christchurch Press. Each of the variables are defined below:

Temperature

The maximum temperature (in degrees C) for each day was recorded for a period of 12 hrs prior to 6:00pm.

Rainfall

The number of millimetres of precipitation falling between 9:00am and 11:00pm on each day was recorded.

Time of Sunset

The time at which the sun was predicted to set was recorded. This information was taken from the New Zealand Nautical Almanac and Tide Tables.

Humidity

The percentage of moisture in the air was recorded for each day.

RESULTS

Summary of Dependent Variables

Figure 1 shows the number of cyclists observed at each location. The University had the greatest population of cyclists, followed by the City Centre, and finally the Polytechnic. In total, 4072 cyclists were observed over 58 observation days. Table 2 below provides a summary of the main findings from observations collected throughout the campaign.

Table 2: Summary of Night time Observations of Cyclists Over the Whole Campaign.

Dependent Measures	Polytechnic	University	City Centre	Total
		Location		
No. Observation Days	27	24	07	58
Total No. Cycles	634	2981	457	4072
Mean No. Cycles	24	124	65	70
% Headlights	52	54	55	53
% Tail lights	49	57	52	53
% Both Head & Tail lights	54	47	44	50
% Helmets	45	50	44	47
% Reflective Gear on the Body	11	5	8	8
% Reflective Gear on the Cycle	45	66	55	55

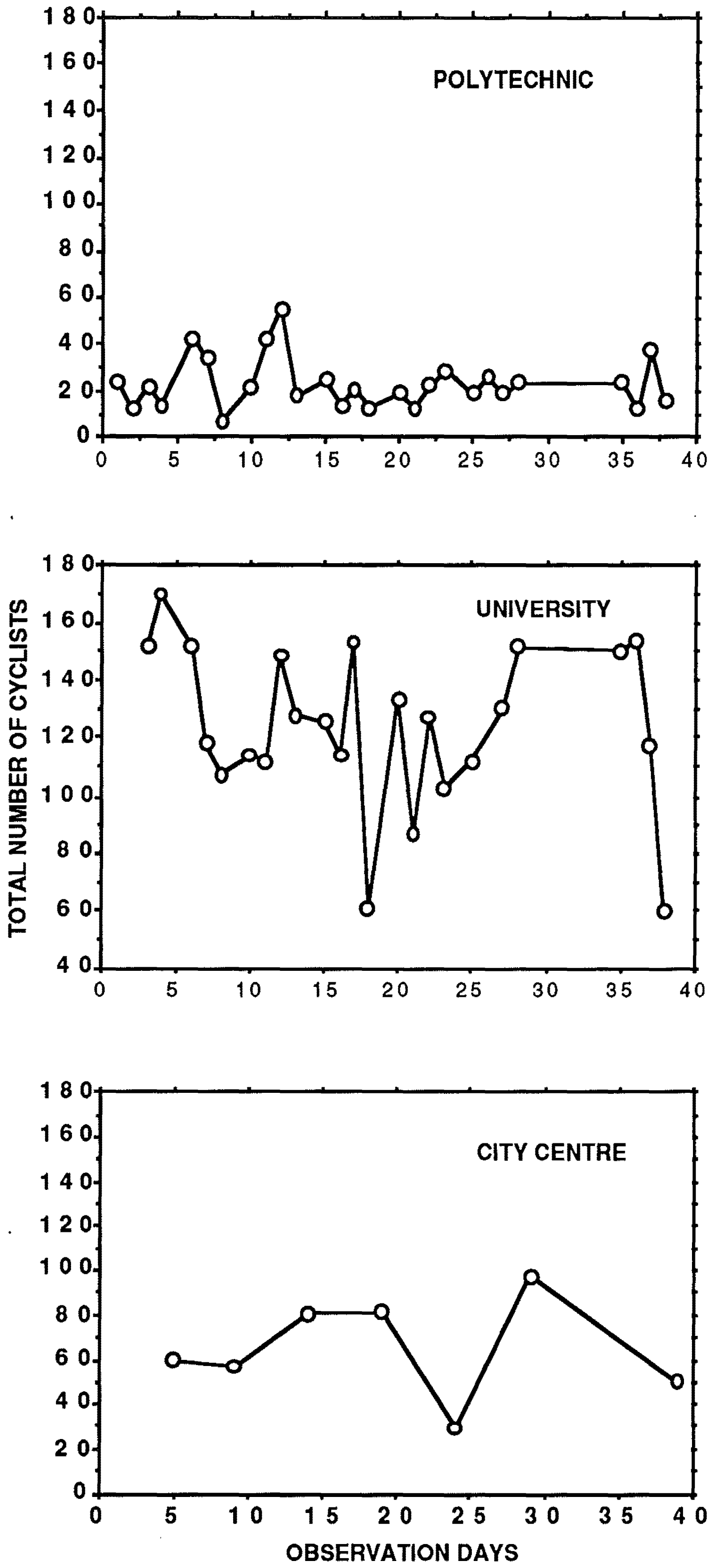

Figure 1. Number of cyclists recorded during night time observations of cyclists at each location.

Overall, the mean percentage of cyclists with full lights was 50% (SD = 12.63), with head lights at 53% (SD = 11.9) and tail lights at 53% (SD = 12.62). The number of cyclists with just head lights differed little across locations, however variations did occur with the number of cyclists with both head and tail lights (Polytechnic 54.%, University 47% & City Centre 44%) and the number of cyclists with tail lights (Polytechnic 49%, University 57% & City Centre 52%). High compliance with one light at a particular location did not necessarily relate to a high compliance with the other. Polytechnic recorded the lowest number of tail lights at 49% but recorded the highest for both sets of lights at 54%

With only 50% of cyclists over the three locations observed with full sets of lights, half of these cyclists are not complying with the Ministry of Transport regulations which state that all cyclists when cycling at night must have both head and tail lights.

The wearing of reflective gear on the body is not a legal requirement. Only a small percentage of cyclists were seen wearing such equipment. The largest percentage recorded was 11% at the University.

Inter Observer Agreement

A second observer made and recorded observations simultaneously for 713 (17%) of the cyclists. The mean percent agreement for all observations made between two observers (calculated as total agreements/ agreements + disagreements x 100) was 94% (range 85% - 96%). Agreement for head lights was 94% (range 91 - 95) and tail lights was 95% (range 89 - 97).

Table 3 below shows the interobserver agreement for all observations taken across the three locations.

Table 3: *Mean Percent Agreement Between Observers Across Locations*

Dependent Measures	Polytechnic	University	City	Total
% Headlights	91	95	94	94
% Tail lights	89	97	93	95
% Helmets	90	97	95	95
% Reflective Gear on the Body	90	99	91	96
% Reflective Gear on the Cycle	90	91	85	90
% Overall	90	96	92	94

Non Experimental Sources of Variance

Meteorological Variables

Climatic factors have the potential to greatly influence patterns of cyclists use of bicycles. As cyclists are particularly exposed to the elements if weather conditions are unfavourable, this is likely to result in fewer cyclists. The impact of weather conditions on cyclists was assessed using correlations between three meteorological variables (humidity, temperature and sunset time) and five dependent variables (total number of cyclists, head light, tail light, both lights and helmet use).

A comparison was made between baseline (consisting of seven observations at Polytechnic, nine observations at University and the first three days in the City) and the remaining three control observations in the City. (The .05 level of significance was used for all calculations.) Only one of the four climatic variables had an impact on cycle light and helmet use during control observations. The higher the temperature, the more cyclists had both head and tail lights (r=.95) and fewer cyclists wore helmets (r=-.95). Rainfall, humidity and sunset time had no affect on control observations. Correlations during baseline conditions across all three locations were low (r<.45) indicating that none of the meteorological variables had an effect during baseline observations.

Correlations between sunset times, rainfall, temperature and humidity across all observations recorded for each separate location are presented in Appendix H. Temperature and rainfall had the most impact of all the climatic variables. The higher the temperature at University (r=.69) and Polytechnic (r=.57), the greater the number of cyclists observed. At University, the more it rained, the fewer cyclists were observed (r=-.70). However, increased rainfall also meant that more cyclists had headlights (r=.57). Those cyclists who braved the bad weather were therefore better equipped with head lights. The amount of rainfall had no impact on the number of cyclists at Polytechnic or the City Centre.

Sunset time had a small impact at University, in that the more light there was at night, the less likely cyclists were to have tail lights (r=-.41) and both head and tail lights (r=-.44). At the City Centre, the same affect occurred with the number of cyclists with tail lights (r=-.77). Time of sunset had no impact at the Polytechnic.

Humidity had an impact only at the University. The higher the humidity, the greater the number of cyclists (r=.57) and the number of cyclists with head lights (r=.43).

In order to determine if the time when the observations were collected (early or late evening) were correlated, a more detailed analysis was carried out. At the University, the number of cyclists increased as the temperature increased during the early (r=.60) and later r=.51) parts of the evening. This effect occurred at the Polytechnic but only during the later evening (r=.57). At the City Centre during the early evening, the number of cyclists with head lights (r=-.77), both lights (r=-.77) and helmets (r=-.79) increased as the temperature decreased. A similar result occurred in the early evening at University with the number of cyclists with head lights (r=-.52), tail lights (r=-.49) and both lights (r=-.41) increasing as the temperature decreased.

Humidity again had an impact only at the University. The total number of cyclists decreased with increased humidity in the early (r=-.45) and later (r=-.45) evening. The number of cyclists with head lights in the early evening increased (r=.44) with increasing humidity.

During early evening at the Polytechnic, the more it rained, the more cyclists were observed with both lights (r=.54) and tail lights (r=.52).This also occurred at the City Centre, with tail lights (r=.75), and head lights (r=.52) and at University, with head lights (r=.53).

Time and Location Variables

Two other non-experimental factors which have the potential to affect the observed percentage of cyclists with cycle lights is the time of night the cyclists were observed (early or late evening), and at which location (University, Polytechnic or City Centre).

Comparing the number of cyclists across all three locations and both time intervals (Table 4) showed that more cyclists were observed during the earlier part of the evening. Overall, 58% of cyclists were observed in the early evening.

Table 4: Number of Cyclists Observed Across Time

Time Interval	Polytechnic	University	City Centre	Total
5.00 - 6.00 PM	325	1799	223	2347
6.00 - 8.30 PM	296	1205	195	1696
	621	3004	418	4043

Overall, across all three locations, the proportion of cyclists using head lights was the same (Table 5, over). At University and Polytechnic however, a much greater proportion of cyclists were using head lights later in the evening, than during the early evening. The same affect was demonstrated for use of both head and tail lights (Table 6).

Table 5: Mean Percentage of Cyclists Possessing Head Lights Across Time

Time Interval	Polytechnic	University	City Centre	Total
5.00 - 6.00 PM	39	46	51	45
6.00 - 8.30 PM	76	73	61	54
	58	60	56	

Table 6: Mean Percentage of Cyclists Possessing Head and Tail Lights Across Time

Time Interval	Polytechnic	University	City Centre	Total
5.00 - 6.00 PM	34	37	40	37
6.00 - 8.30 PM	58	56	47	54
	46	47	44	

A smaller proportion of cyclists at the Polytechnic had tail lights than at either of the other locations (Table 7, over), but the Polytechnic had the greatest proportion of tail light use in the late evening.

The number of cyclists wearing helmets were about the same during early and late evening at the University and Polytechnic, and early evening at the City Centre (Table 8, over). A larger proportion of cyclists however were wearing helmets during the later part of the evening at the City Centre.

Table 7: Mean Percentage of Cyclists Possessing Tail Lights Across Time

Time Interval	Polytechnic	University	City Centre	Total
5.00 - 6.00 PM	35	50	51	45
6.00 - 8.30 PM	72	63	60	65
	54	57	56	

Table 8: Mean Percentage of Cyclists Possessing Helmets Across Time

Time Interval	Polytechnic	University	City Centre	Total
5.00 - 6.00 PM	44	48	50	37
6.00 - 8.30 PM	44	49	61	54
	44	49	56	46

Table 9: Number and Percent of Cyclists Recorded Across Observation Sites and Time Intervals

Location	N	%
University		
S1: cnr Clyde Rd & Kirkwood Ave	997	33
S2: cnr Kirkwood Ave & Ilam Rd	609	20
S3: cnr Ilam & Creyke Rds	584	19
S4: cnr Clyde & Creyke Rds	839	27
5.00 - 6.00 PM	1815	60
6.00 - 8.30	1214	40
Polytechnic		
S1: cnr Allen & Madras Sts	288	45
S2: cnr Williams & Coventry Sts	214	34
S3: cnr Moorhouse Ave & Madras Sts	132	21
5.00 - 6.00 PM	326	51
6.00 - 8.30 PM	308	49
City Centre		
S1: cnr Moorhouse Ave & Colombo St	104	23
S2: cnr Armagh St & Rolleston Ave	173	38
S3: cnr Bealey Ave & Victoria St	113	25
S4: cnr Fitzgerald Ave & Worchester St	67	14
5.00 - 6.00 PM	260	57
6.00 - 8.30 PM	197	43

A breakdown of the number and percentage of cyclists observed across all three locations at each site, and across both time periods, is shown in Table 9 (previous page).

Experimental Sources of Influence

The headlight, tail light and helmet usage during each phase of the intervention is summarised in Table 10. This information is also presented in Figures 2 to 5.

Table 10: *Mean Percent of Cyclists Observations for Each Experimental Condition Across Locations*

Dependent measures	Experimental phases: Baseline	Prompting	Incentive	Enforcement	Maintenance
City					
No. Observ. Days	7				
% Head lights	56				
% Tail lights	55				
% Both lights	46				
% Helmets	46				
University					
No. Observ. Days	09	04	04	03	04
% Head lights	51	62	54	55	49
% Tail lights	54	65	58	60	53
% Both lights	45	54	48	50	38
% Helmets	49	53	51	53	48
Polytechnic					
No. Observ. Days	06	04	04	04	08
% Head lights	69	44	46	51	50
% Tail lights	55	44	41	47	47
% Both lights	53	41	51	45	58
% Helmets	45	38	40	46	46

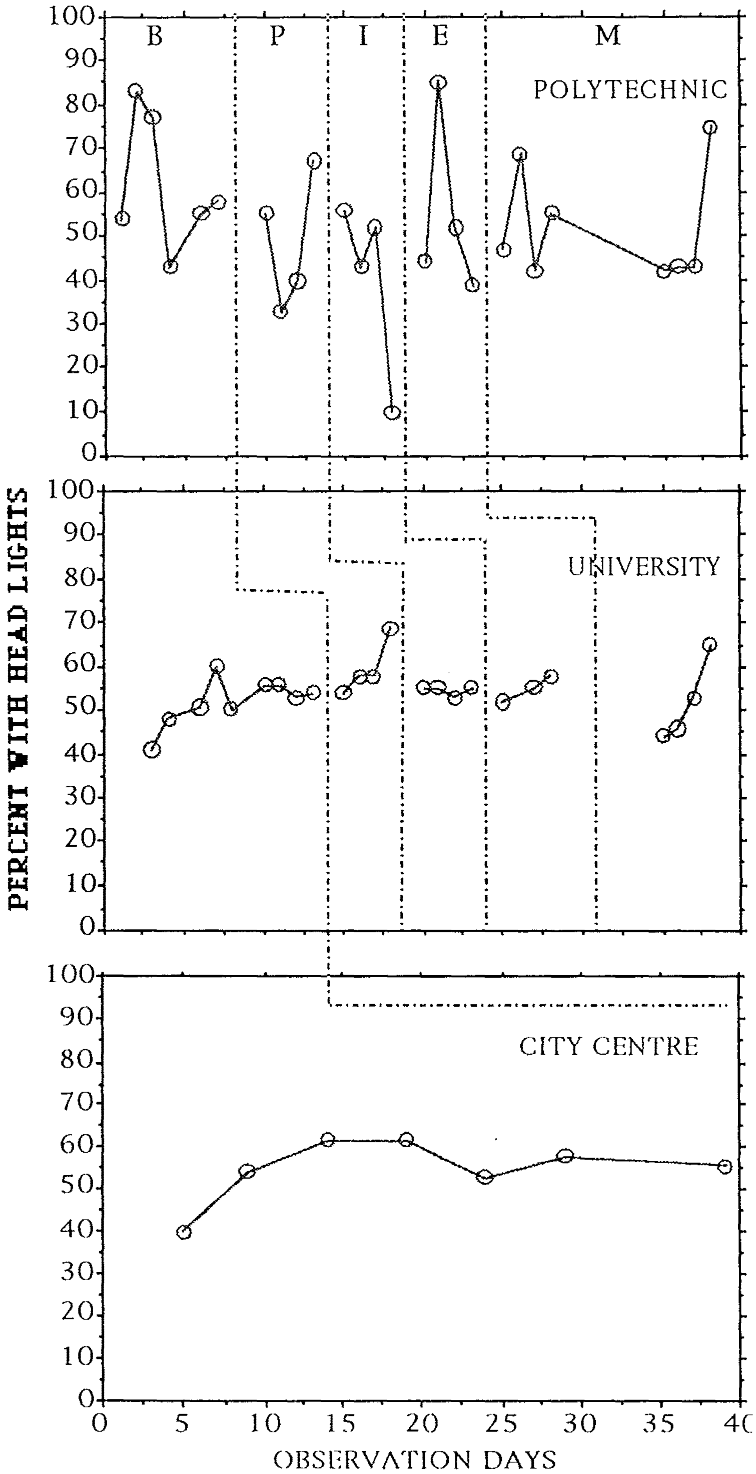

Figure 2 Daily percentage of head light usage for night time cyclists at each location during successive experimental phases. B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

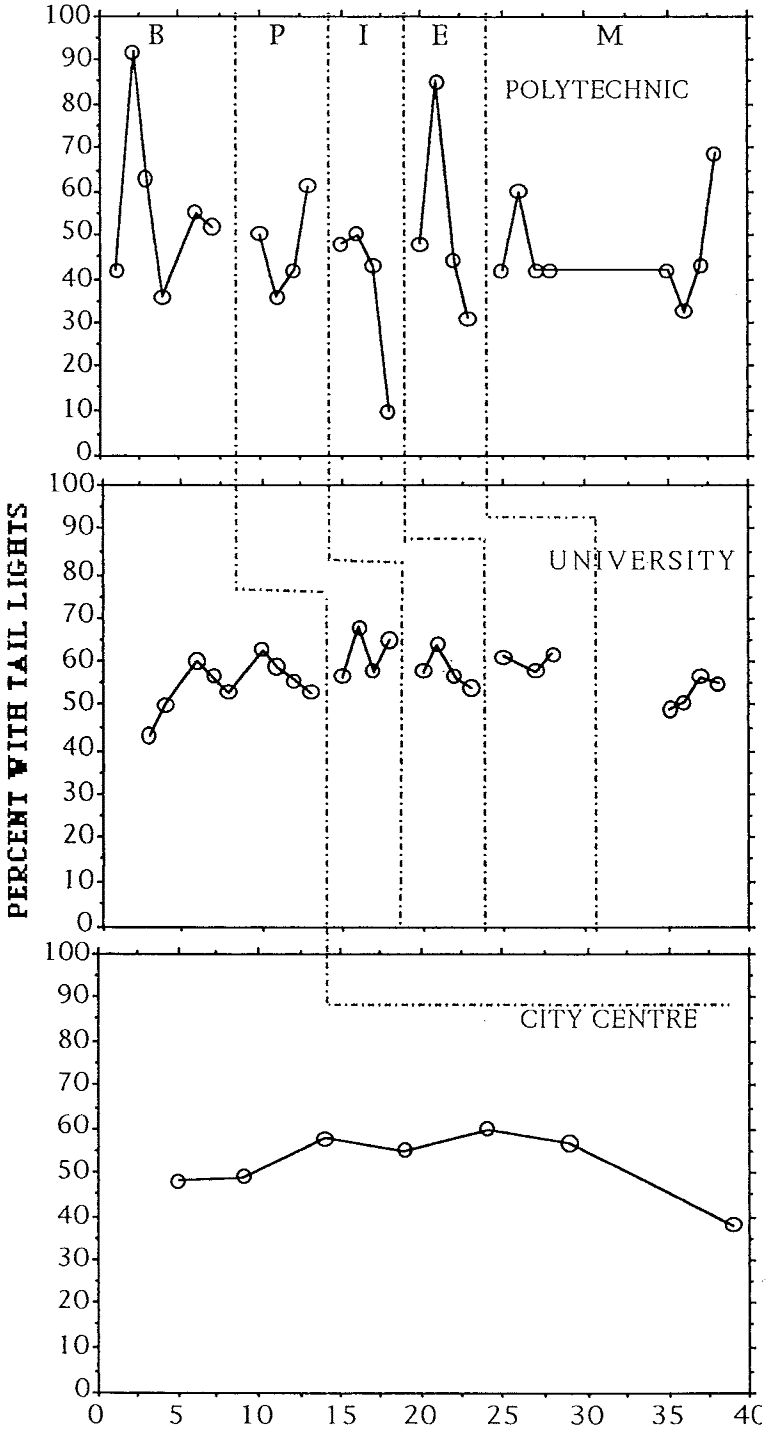

Figure 3 Daily percentage of tail light usage for night time cyclists at each location during successive experimental phases. B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

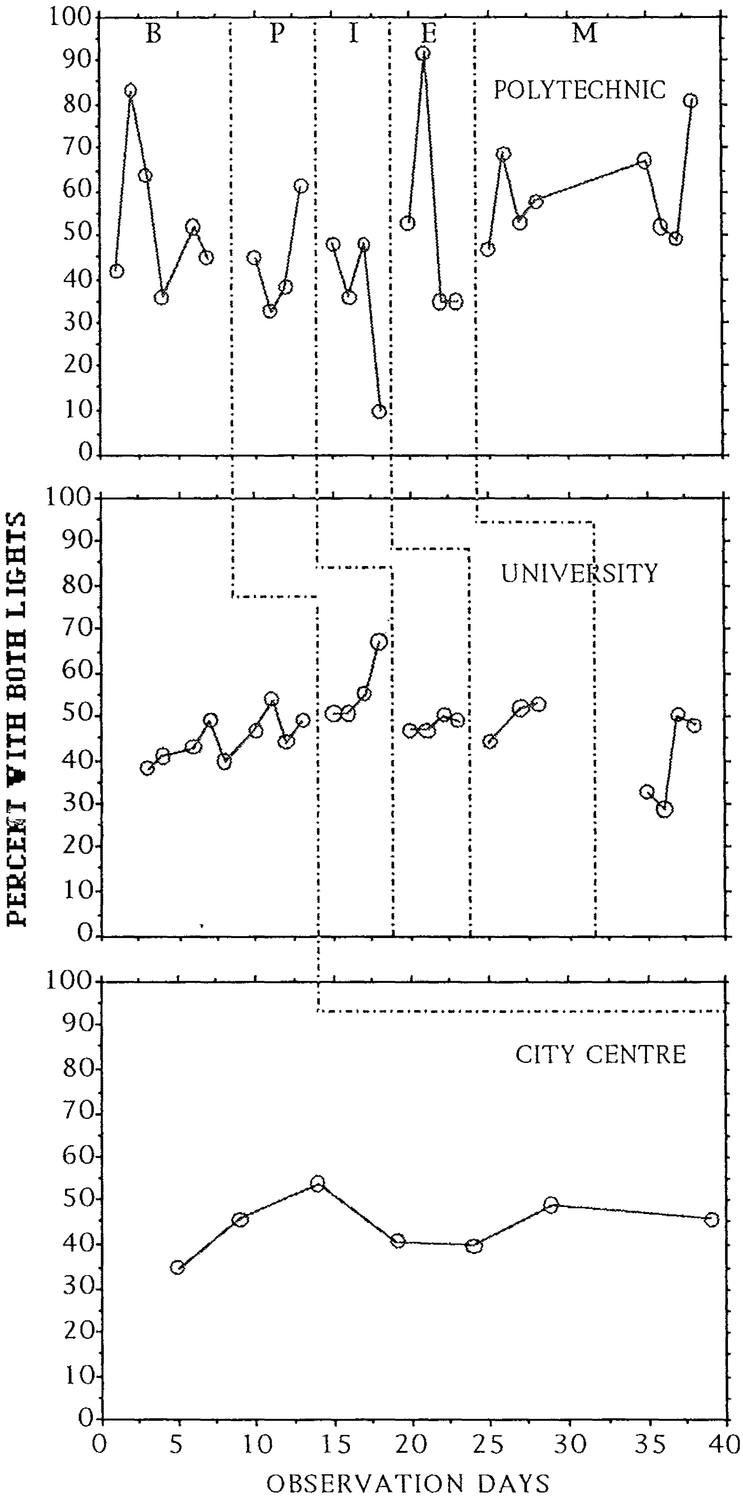

Figure 4 Daily percentage of both head and tail light usage for night time cyclists at each location during successive experimental phases.
B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

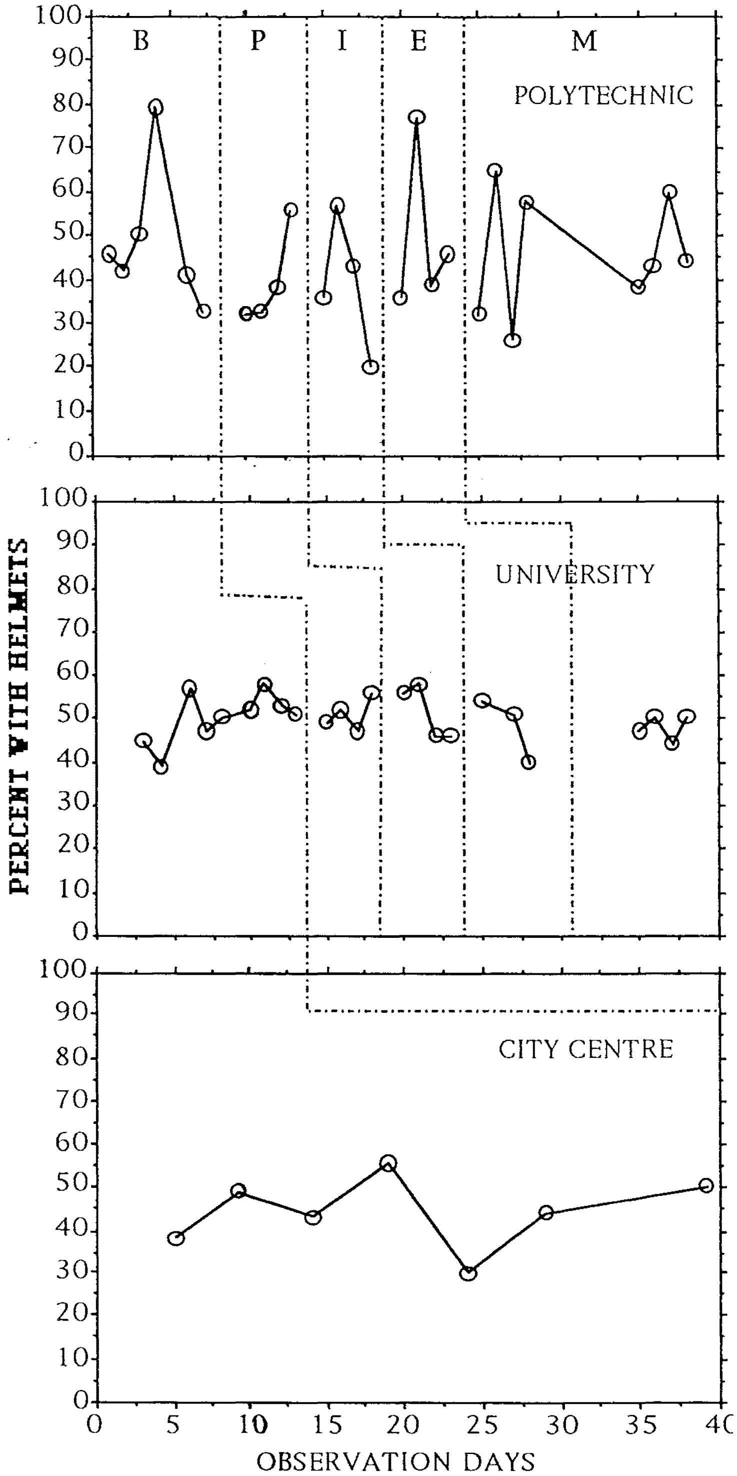

Figure 5 Daily percentage of helmet usage for night time cyclists at each location during successive experimental phases. B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

City Centre

Observations in the central City Centre show a gradual increase in the use of head lights, and tail lights during the first three to four weeks. This then stabilises but drops noticeably on the final observation for tail lights. For cyclists using both lights, there was a similar increase in the first three observational periods, followed by a dip in the middle period, but a recovery period for the final observations. Helmet use follows a similar trend, but is more unstable.

University

For all observations at University for the numbers of cyclists with head lights, tail lights, both lights and helmets, there was an increase in use during the initial period of observations, followed by a slow decrease over the remainder of the period. Due to the short duration of the phases, it is difficult to make any clear distinctions between the next three phases. Before the maintenance phase, there is a drop in usage across the board, followed by an increase within this phase. The decrease just before maintenance phase could have been affected by the mid term break which occurred at this time. The increase in use which occurred later in the maintenance phase could be due to a delayed effect from the previous enforcement phase. Word may have been passed around that the Ministry of Transport were fining those cyclists found without cycle lights. Interestingly, a similar effect was found for helmet use, which at the time, was not a legal requirement.

Polytechnic

No clear conclusions can be drawn from this data due to the wide variations of usage in each phase. Not enough cyclists were observed to be able to make clear inferences from these results.

Overall, it is not possible to make any clear inferences that the intervention phases had any impact on the use of head lights, tail lights, both lights or helmets.

It had been hypothesized that those cyclists who cycled later at night were more likely to be better prepared, than those cycling earlier in the evening who had simply under-estimated time of sunset. To look into this, a subsequent analysis divided observations into two time periods: early (5.00 - 6.00pm) and late (6.00 - 8.30pm).

The head, tail light and helmet usage during each phase of the intervention is summarised in Table 11. This information is also presented in Figures 6 to 9.

Dividing the observations into two distinct time frames, still resulted in wide fluctuations of the use of head, tail, both lights and helmets across phases.

Table 11: Mean Percent of Observations Across Successive Time Intervals Across Locations

Dependent measures		Experimental phases				
		Baseline	Prompting	Incentive	Enforcement	Maintenance
City						
No. Observ. Days		09				
% Head lights	E	51				
	L	61				
% Tail lights	E	51				
	L	60				
% Both lights	E	40				
	L	47				
% Helmets	E	50				
	L	61				
University						
No. Observ. Days		09	04	04	03	04
% Head lights	E	43	52	49	51	45
	L	65	72	61	69	73
% Tail lights	E	49	57	51	53	50
	L	65	69	68	72	63
% Both lights	E	33	43	40	43	34
	L	52	58	56	64	58
% Helmets	E	50	53	52	47	48
	L	48	49	52	51	48
Polytechnic						
No. Observ. Days		06	04	04	04	08
% Head lights	E	55	16	40	19	26
	L	72	70	76	60	76
% Tail lights	E	50	20	26	15	25
	L	64	63	71	56	72
% Both lights	E	49	17	26	15	27
	L	62	63	71	44	72
% Helmets	E	56	31	50	27	43
	L	34	42	32	46	53

E= 5.00 - 6.00pm; L= 6.00 - 8.30pm.

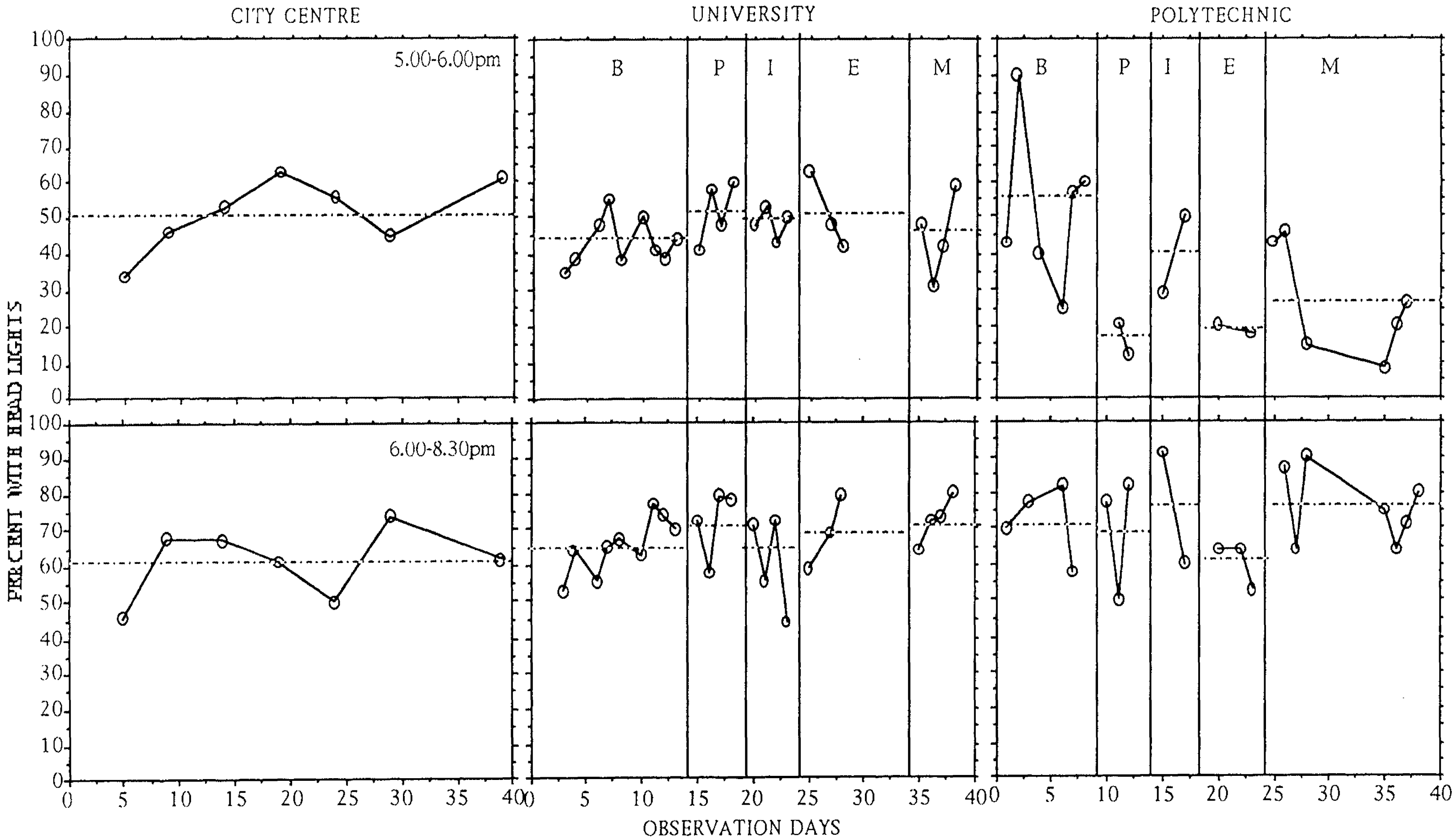

Figure 6 Percentage of cyclists using head lights at two observation times. The dotted horizontal line indicates the mean percentage for each phase. B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

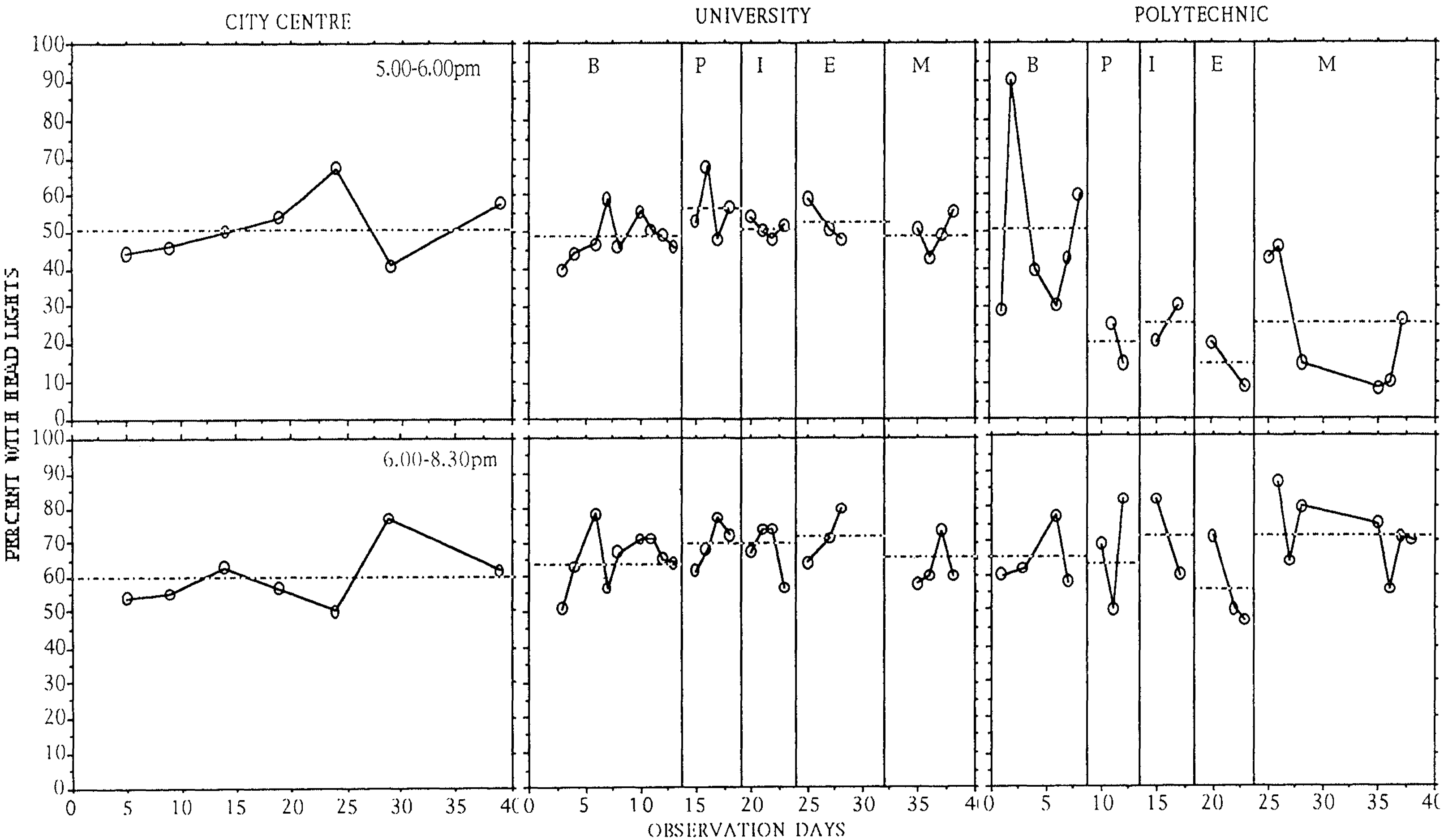

Figure 7 Percentage of cyclists using tail lights at two observation times. The dotted horizontal line indicates the mean percentage for each phase.
B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

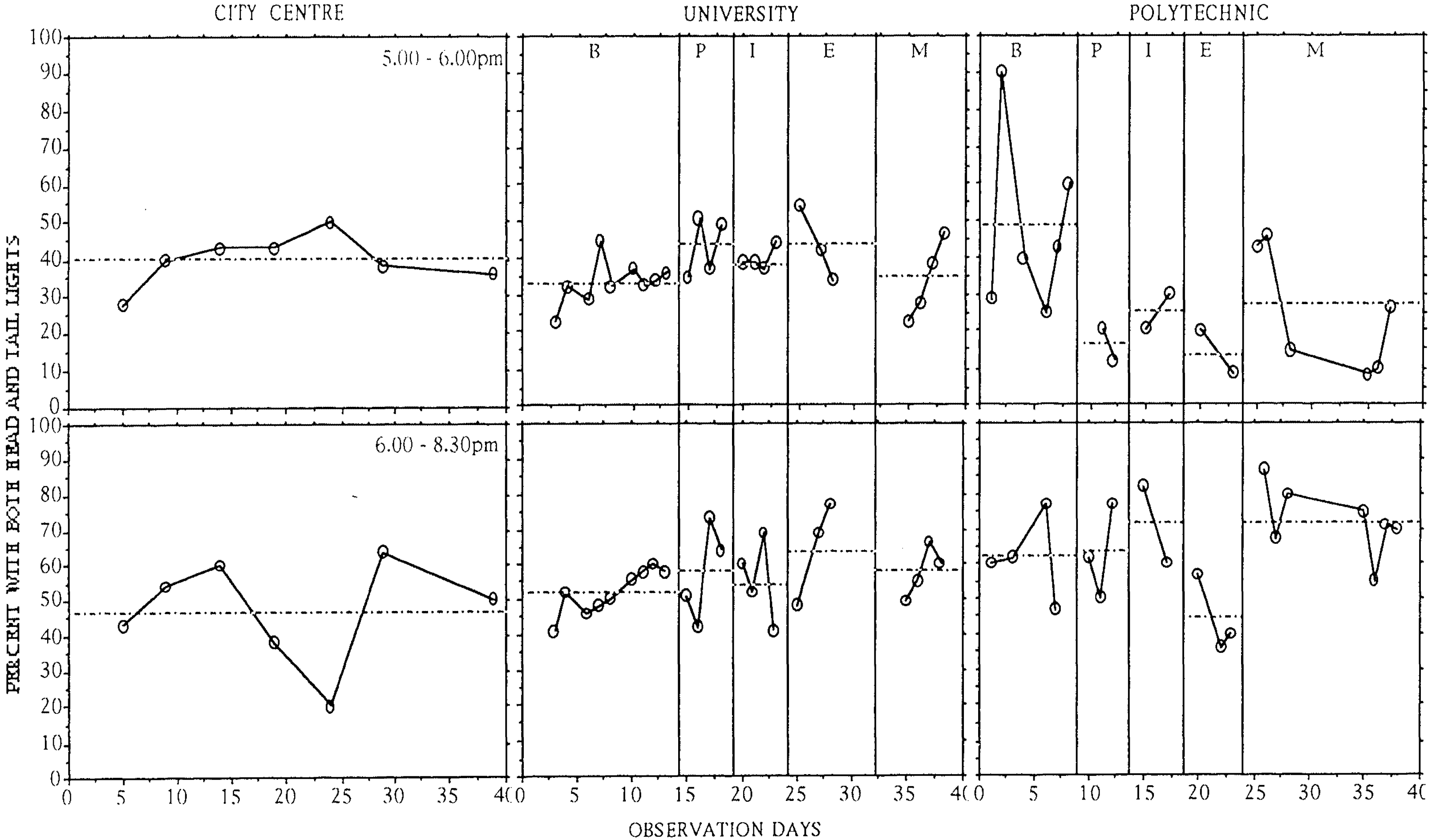

Figure 8 Percentage of cyclists using both head and tail lights at two observation times. The dotted horizontal line indicates the mean percentage for each phase. B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

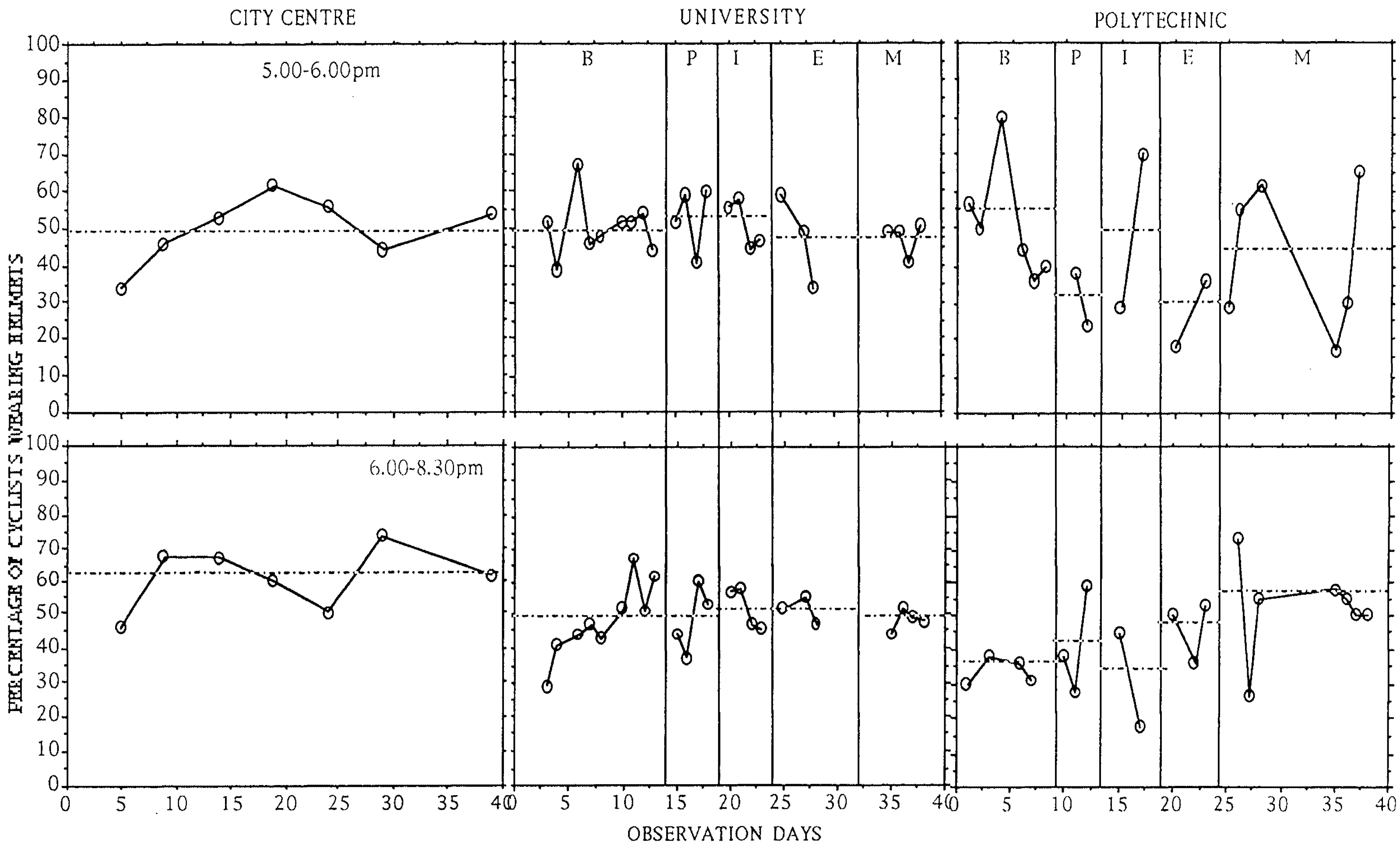

Figure 9 Percentage of cyclists wearing helmets at two observation times. The dotted horizontal line indicates the mean percentage for each phase.
B = baseline; P = prompting; I = incentive; E = enforcement; M = maintenance

Polytechnic

The fluctuations in the use of lights and helmets were particularly evident at the Polytechnic. Here, when there were fewer than cyclists observed in any one time frame, those cyclists were removed from the data set. As analysis of the data were carried out on percentages, small numbers would have had the potential to severely bias the results. Even after eliminating these days from the from the analysis, the variations were too wide to support any clear conclusions about the affect the intervention had on cyclists' use of cycle lights and helmets.

City

The same basic pattern which occurred for the total observations (see Fig. 2), was obtained. However, the mean percent for head light, tail light and helmet use was at least 10% higher for the later time period. Both lights had a 7% increase over the same period. This result supported with the hypothesis that those cyclists riding later at night would be better prepared.

University

During the early and late part of the evening, the mean percent using head lights across phases remained relatively constant, however there was an approximately 30% increase in usage during the later part of the evening.The same was found for the use of tail lights, and a similar, but not as strong result was found for the use of both head and tail lights. During the two time periods, there was not much difference across phases for helmet usage.

In summary, analysis of the data by early and late evening clearly shows an increase in the mean percentage of cyclists equipped with head lights, tail lights and helmets in the later time period of 6.00 - 8.30pm. However, there again appears to be little to support the conclusion that the intervention had an impact on increasing the number of cyclists using head lights, tail lights and helmets. The amount of overlap between results obtained from the previous experimental conditions was too great to demonstrate any real impact the interventions may have had. The great variability demonstrated at the Polytechnic is likely to be related to the small absolute number of cyclists observed overall at that location Even minimal differences in observed use gave rise to accentuated percentage scores, which in turn led to the large fluctuations. At the University, it was difficult to draw any clear conclusions about the impact of each phases due to the few number of days allocated to each phase.

Cycle Safety Awareness Evaluation Questionnaire

Results of the questionnaires are divided into four separate categories and depicted in Table 12 to 15. One hundred questionnaires were given to each of the before and after groups at each location, giving a total of 400 completed questionnaires. The mean percentage (and absolute numbers) scores of student's responses to the questionnaire both before and after the experimental interventions are compared in Table 12. Student's attitudes towards cycle safety are described in Table 13. Their intention to purchase cycle safety equipment is demonstrated in Table 14. The number of students aware of the competition being run at the book shops, enabling them to win back the purchase price of their lights is shown in Table 15.

University

Between baseline and follow-up, there was a significant increase in the number of students who reported owning head lights, tail lights, reflective gear for their bodies, and reflective gear for their cycles. The number of cyclists stating they had helmets stayed the same, but it was an impressive 60% of cyclists who said they already owned a helmet.

A large proportion of cyclists indicated that they regularly cycle at night. A small proportion of cyclists had heard messages encouraging the use of cycle lights prior to initiation of the campaign. This is possibly due to a small amount of outside media interest in the area of cycle safety, just prior to the intervention programme. Over half the cyclists interviewed after the intervention recalled hearing something encouraging the use of cycle lights, showing that the prompting phase of the intervention had had some positive results. The posters, leaflets, radio announcements, and newspaper article all had some impact, the greatest from the leaflet drop onto individual bicycles.

Table 12. Mean Percentage Scores for University and Polytechnic Student's Responses to Baseline and Follow-up Administrations of the Cycle Safety Awareness Questionnaire.

Questionnaire Item	Mean Responses: University Baseline %	University Follow-up %	Polytechnic Baseline %	Polytechnic Follow-up %
1. Sex:				
Female	35	48	43	49
Male	65	52	57	51
2. Own the following:				
Headlight	69	83	70	76
Tail light	69	83	69	70
Helmet	62	67	75	68
Reflective gear on the body	29	35	21	21
Reflective gear on the cycle	22	41	16	36
3. Regularly cycle at night:	62	73	65	61
4. Heard something encouraging use of cycle lights:				
last week:	15	28	24	15
last month:	24	60	17	49
Poster	01	23	02	07
Leaflet	00	28	00	38
Radio	17	18	04	10
Article	13	21	16	05
Word of Mouth	10	03	10	03
Other	05	15	09	16
9. The time at which lights are legally required:				
No idea	12	07	15	26
wrong	03	03	18	01
partly right	14	11	25	29
almost right	24	32	13	39
correct	47	29	29	23

Before the intervention began, only 47% of cyclists knew that the legal time from when lights are required, is 30 minutes after sunset. This decreased to 29% after the intervention.

Polytechnic

The proportion of cyclists reporting ownership of head lights, tail lights and helmets were all high (approximately 70%) and this did not differ from baseline to follow-up. The number of cyclists with reflective gear on their cycles doubled from 16% to 36% at follow-up.

Again a large number of cyclists reported regularly cycling at night. At least half of the students in the follow-up questionnaire had reported hearing something encouraging the use of cycle lights in the last month. The leaflet had had the greatest impact at the Polytechnic also. The number of students who knew the time lights were legally required was low before the intervention, and remained low at follow-up.

Summarising the above, a high proportion of cyclists report that they already own head lights, tail lights and helmets. The proportions did not change markedly from baseline to follow-up. A large proportion of cyclists at both locations state that they regularly cycle at night. More than half the students were aware of the intervention at follow-up. Only a small proportion of cyclists were aware of the time at which lights are legally required at night.

The cyclists' responses to the cycle safety attitude questions (see Table 13) showed that the University cyclists perceive cycling in Christchurch as being dangerous. Thirty eight percent of cyclists stated this to be the case before the intervention, and the proportion rose to 53% after the campaign. Polytechnic cyclists stated that cycling was dangerous before the intervention, but afterwards there was a shift to 42% of cyclists strongly agreeing that cycling was a dangerous activity.

Table 13: Student's Responses to Cycle Safety Attitude Questions

	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree	
	B	F	B	F	B	F	B	F	B	F
5. Cycling in Christchurch is Dangerous										
Uni	15	11	38	53	19	13	24	22	04	01
Tech	15	42	43	28	21	11	20	17	01	02
6. Reflectors alone are adequate when cycling at night.										
Uni	03	01	04	03	32	02	61	45	00	49
Tech	03	01	47	08	00	05	50	47	00	39
7. Helmets are essential										
Uni	35	38	35	32	20	08	10	02	00	01
Tech	46	39	38	21	13	09	03	15	00	06
8. Important to have both head and tail lights at night.										
Uni	73	54	21	39	04	03	02	03	00	01
Tech	80	61	00	31	20	06	00	02	00	00

(B= Baseline; F= Follow-up)

When asked before the intervention if they thought that reflectors alone were adequate when cycling at night, the majority of University cyclists disagreed, or were undecided. After the intervention, the cyclist's attitudes changed to either disagree or strongly disagree.

At the Polytechnic before the intervention, half the cyclists disagreed and half agreed that reflectors alone were adequate when cycling at night. After the intervention, a similar result to University was found in that the majority either disagreed with the comment, or strongly disagreed.

The majority of both Polytechnic and University cyclists felt that helmets were an essential piece of equipment, and this attitude was consistent both before and after the intervention. a similar result was found for the question relating to the importance of having both head and tail lights at night.

Students' intentions to purchase safety equipment are depicted in Table 14. (over). At the university, 67% of cyclists stated that they already owned lights, and this rose to 81% at the completion of the intervention. At the Polytechnic, 71% of cyclists state they had cycle lights before the intervention, but after the intervention, only 17% of those cyclists surveyed had lights. Of these cyclists, only 12% stated that their intention was to purchase lights.

With reflective clothing, approximately 20% of cyclists at both University and Polytechnic already owned such equipment. This figure was the same both before and after the intervention. Very little indication was given that the cyclists without reflective clothing had any intentions of purchasing such equipment.

The number of cyclists with reflective gear on their bikes at both University and Polytechnic doubled after the intervention. However, those cyclist without reflectors showed little intention of purchasing them.

The number of cyclists who stated that they owned helmets before the intervention is quite high, at 60% for University cyclists and 70% for Polytechnic cyclists. A similar number of responses was given after the intervention. Again, those who did not already own helmets did not appear to have any great intentions of purchasing them.

Table 14. Mean Percentage Scores for Student's Intention to Purchase Safety Equipment

10. Plan to purchase any of the following?

	Yes -Don't own		No-Don't own		No-Already own	
	Before	After	Before	After	Before	After
Lights						
Uni	05	05	07	14	67	81
Tech	22	12	28	77	71	17
Reflective Clothing						
Uni	03	03	74	72	23	25
Tech	06	03	76	77	18	17
Reflectors						
Uni	03	02	76	55	21	43
Tech	07	01	78	61	15	38
Helmet						
Uni	05	05	33	30	62	65
Tech	06	05	17	27	77	68

A large number of cyclists consider cycling to be dangerous. After the intervention, the majority of cyclists felt that reflectors alone are not adequate when cycling at night. The majority of cyclists felt that helmets were an essential piece of equipment, and that it is important to have both head and tail lights when cycling at night.

Approximately 40% of students at both University and Polytechnic were aware of the competition enabling students to win back the purchase price of their lights (Table 15).

Table 15: Question Relating to Student's Awareness of Competition to Win Back Purchase Price of Light
(Question administered only at follow-up)

	UNI %	TECH %
11. Aware of competition?	42	45
a) How did you notice?		
poster	43	07
Leaflet	19	84
Radio	12	00
Article	19	00
Other	26	13
b) Knew how to win?	55	51
c) Knew the prize?	69	67
12. Entered competition?		
No- didn't know how	02	08
No- already own	55	40
No-couldn't afford	05	20
No-other	28	32
Yes	10	90

Of those students who were aware of the competition, the majority of the University cyclists had heard about it through posters, but at the Polytechnic, the leaflets had had the greatest impact. About 70% of the cyclists knew that the prize was the chance to win back the purchase price of the lights, and half the cyclists knew what was required in order to win. Only 10% of the University cyclists interviewed had entered the competition, however the reason that 55% gave for not purchasing them, was that they already owned lights. At the Polytechnic, 90% of those interviewed stated that they had entered the competition.

These results give a clear indication that a large proportion of cyclists were aware of the competition, and they were aware of what was required to win the prize. A surprisingly small proportion of University cyclists entered of those interviewed, but over half claimed that they already owned lights.

A comparison was then made of any differences between the observed number of cyclists with head lights, tail lights, helmets, reflective gear on the body, and reflective gear on the cycle, and the reported possession of such equipment from the cyclists interviewed with the Cycle Safety Awareness Questionnaire, displayed in Table 16 (means for the questionnaire are averaged from the before and after questionnaires for both locations).

Table 16: Comparison of Mean Percentage Scores Between Questionnaire and Observation Strategies.

	Mean Responses			
	University		**Polytechnic**	
Equipment	Question. %	Observ. %	Question. %	Observ. %
Head light	76	54	73	52
Tail light	76	57	70	49
Helmet	65	50	72	45
Reflective gear on body	32	05	21	11
Reflective gear on cycle	32	66	26	45

For each piece of equipment there are large discrepancies between what was observed and what cyclists stated they owned. Considerably more cyclists stated they owned head lights, tail lights, helmets, reflective gear on their bodies and reflective gear on their bikes, than was actually observed.

Meteorological Variables

As mentioned in the Method section, a number of meteorological variables were recorded for each observation day throughout the campaign. Figures 10 to 13 show the variation in weather conditions over the experimental period. Generally, the weather conditions during this time, were similar to previous years.

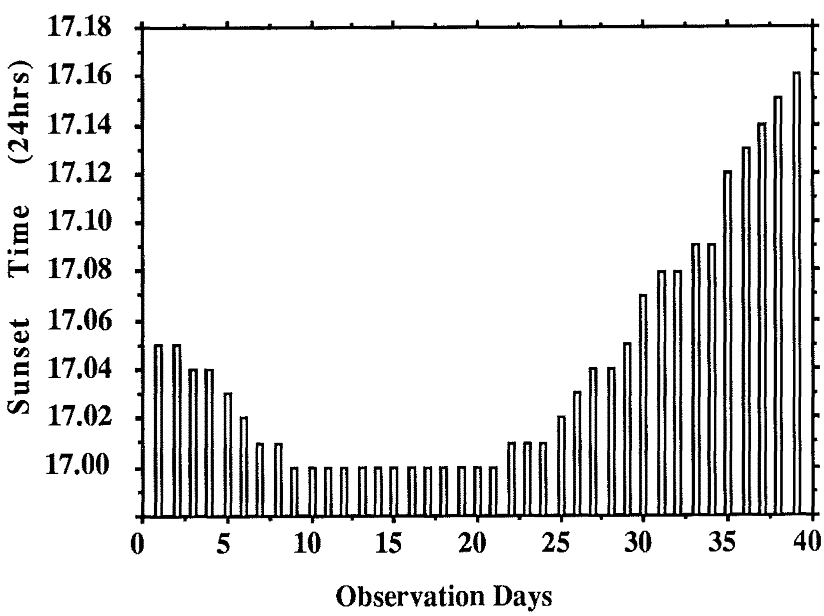

Figure 10 : Variation in time of sunset over the duration of the experiment.

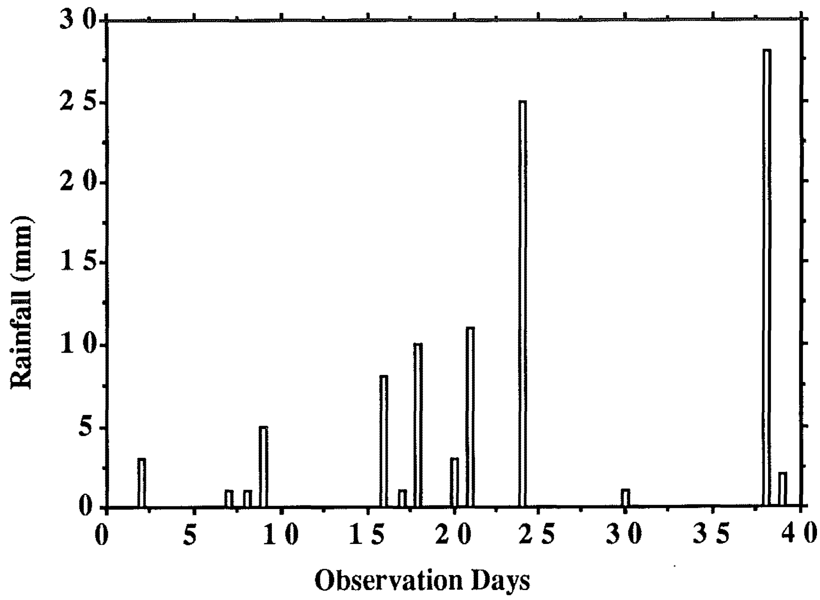

Figure 11 : Variation in daily rainfall over the duration of the experiment.

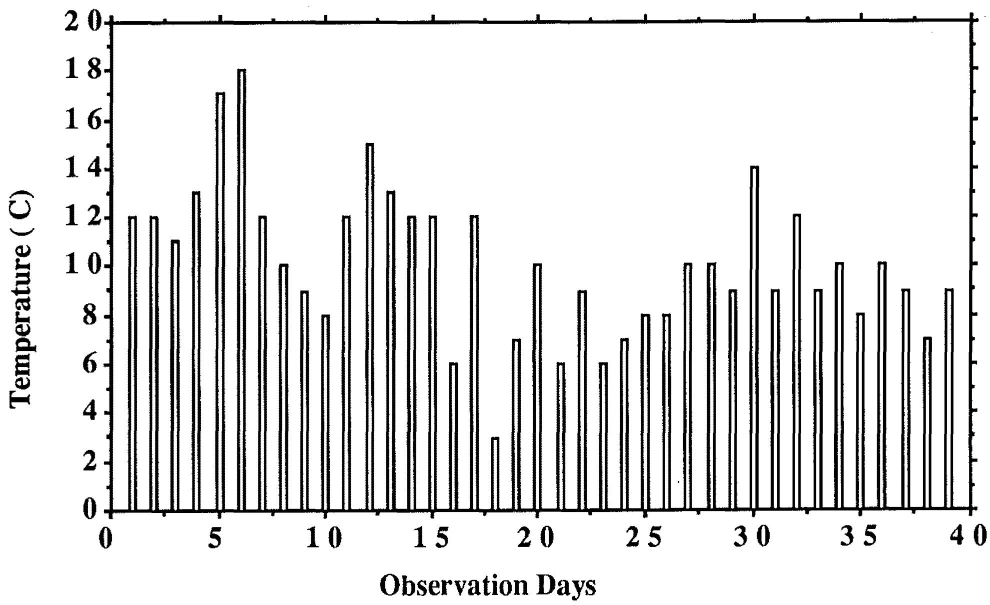

Figure 12 : Variation in daily temperature over the duration of the experiment.

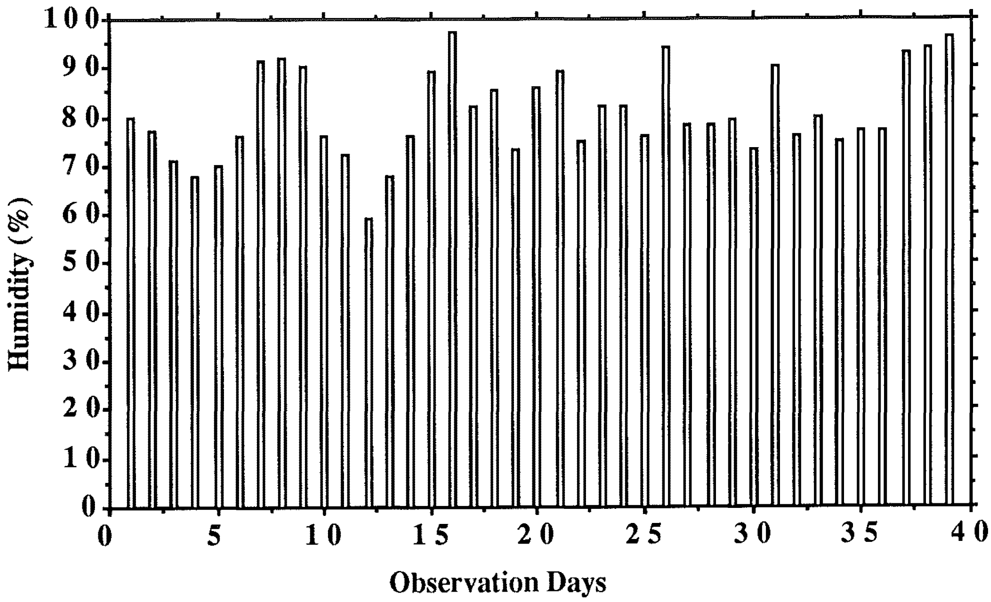

Figure 13 : Variation in daily humidity over the duration of the experiment.

DISCUSSION

A large number of accidents resulting in injury and death of cyclists occur on New Zealand roads each year. One of the probable leading causes of this is the lack of visibility of the cyclists to other road users. It has been shown that only approximately half of night time cyclists in Christchurch consistently equip themselves with the legal requirements of both head and tail lights. This is despite the implementation of the intervention campaign which introduced a number of different modification strategies. The wearing of reflective equipment is not a legal requirement, but has been recommended by some researchers as being a particularly effective way of increasing visibility (Noordzij, 1976; Olson et al, 1981; Atkinson & Hurst, 1984; Shinar, 1984; Watts, 1984; and Collins, 1989). Only a small percentage of cyclists was observed wearing reflective gear such as reflective sashes and body lights. A significant proportion of cyclists was observed to be wearing helmets, even thought at the time the intervention was carried out, these were not a legal requirement.

The results of the intervention show that the introduction of a behaviour modification intervention comprising prompting, incentive, enforcement and maintenance phases, was not effective as a means of increasing the proportion of cyclists using lights while cycling at night. This result is similar to Ferguson's (1987) study. For each of the variables which contributed to the failure of Ferguson’s study, an attempt was made to control for these in the current study.

In Ferguson's study, the time at which the sun set was found to be a major contributing factor as to whether or not cyclists were using lights at night. The present study, in order to combat this, was restricted to the darkest period of winter. By doing this, the proportion of cyclists with lights was not shown to correlate with time of sunset. One potential problem with this restriction proved however, to be that insufficient time was allocated to each of the intervention phases. There was not enough time for any impact of each phase to be demonstrated.

The only meteorological variable which was shown to have any major impact on the number of cyclists with lights in this present study was rainfall, and only at the University. More cyclists were observed using head lights on wetter days. Temperature at University and Polytechnic was shown to have an influence on the absolute number of cyclists. Predictably, the warmer the weather, the more cyclists were observed.

The second variable other than fluctuating weather conditions in Ferguson's study to have a major impact on the number of cyclists observed using cycle lights was time of night. The percentage of cyclists using cycle lights varied inversely with changes in natural daylight levels. These non-experimental factors largely accounted for the proportion of cyclists using cycle lights at night. Even when the influence of these extraneous variables was minimised by analysing the proportions of cyclists using lights at late evening versus early evening, significant improvements were still not found. Although some small increases were demonstrated, these were not statistically significant, nor maintained over the duration of the experiment.

A variety of intervention phases for the observation section were selected, as prior behaviour modification literature have demonstrated that in order to be able to achieve the desired change in the behaviour, simply presenting information is not enough. Education is the first step, but additional techniques are necessary to promote a change based on the new knowledge (Langley et al., 1987). In the specific cases where prompts have been successfully employed alone, they were in the form of specific requests delivered at the exact time and location for the desired response and concerned behaviours which were relatively convenient to emit. (Beaglehouse, 1990)

With Ferguson's study, the use of a large financial reward was not found to make a significant impact. It was suggested that the opportunity to win $100 was not valued highly by students and therefore did not function as an incentive. It did not have a great deal of success in encouraging students who already had a complete set of lights fitted to their cycles to enter the competition, let alone provide enough motivation for those without lights to purchase them. He suggested that a number of variables such as financial cost, amount of effort required, the frequency with which the desired behaviour must occur, and the perceived consequences that may result from not responding all have an impact on the decision to change a behaviour. The behaviour targeted in both Ferguson's and the present study was the purchasing of, and using cycle light equipment. The purchasing requires a large initial investment, but only needs to be performed once. The aim of having the lights available on campus so that cyclists did not have to make the effort of going to a cycle retailer and having them available at a discounted rate, plus offering the chance to win back the purchase price of the lights was to provide a more effective incentive. Although only 10% of the cyclists at University interviewed with the Cycle Safety Awareness Questionnaire stated that they had entered the competition, a total of 92 sets of head and tail lights were sold from the University Bookshop. A corresponding increase in the number of cyclists with head and tail lights did not occur during night time observations of cyclists during the incentive phase. Possibly these cyclists were not cycling around the University at times when the observations were occurring. Even though there was not a noticeable increase in the number of cyclists using head and tail lights, this intervention phase was successful in that the number of cyclists with full set of lights did increase.

Ferguson used performance feedback as an intervention phase, however it proved not to produce a significant impact. It was thought that this was due to an insufficient exposure period of a feed-back sign informing the number of cyclists observed the prior night with both head and tail lights. It was not possible to prolong the feedback condition due to the seasonal nature of the target behaviour, which predominantly occurs during the three months of winter, when the cycle light problem is at its worst. Performance feedback was therefore not used as an intervention phase in the current study.

The suggestion to use a negative consequence component in any future similar interventions was made by Ferguson. Enforcement has been shown to be very effective in reducing speeding. Cyclists are legally required to use head and tail lights while cycling at night. It was thought that being stopped by a Traffic Officer from the Ministry of Transport (MOT) and being fined $35 for each light missing would be act as a substantial motivation to purchase and use lights. However, there did not appear to be any significant increase in cycle light use during the enforcement phase. One possible reason for this is the short duration of this phase, particularly at University, with one of the four days of data missing. At the Polytechnic, 18 cyclists were stopped who did not have a functional set of head and tail lights. Of those, 15 were warned, and 13 were issued with offence notices. Bad weather on the nights the MOT were carrying out spot checks at the Polytechnic, meant that very few cyclists braved the bad weather. At the University, 135 offence notices were issued and 31 cyclists were warned. The notices required the fine to be paid unless the cyclists turned up the following day with either a set of lights, or a receipt as proof of purchase. Those stopped were also advised that lights could be purchased from the book shops on campus. Again, the enforcement phase appears to have had a large impact on individual cyclists, but the impact failed to be demonstrated in the actual observations of cyclist using head and tail lights during this phase. However, there appears to be a delayed affect of the enforcement phase occurring at University, during the maintenance phase. It is possible that this increase occurred as word had now passed around warning about the MOT's checks. Perhaps future advertising that the MOT were to be carrying out spot checks on the use of head and tail lights may increase the number of cyclists complying with the legal requirements.

The difficulty in prolonging the length of each intervention phase for the current study, recommended again with the enforcement phase, is the same as with Ferguson's study in that the observational period is restricted to the darkest periods of winter. Suggestions for future studies could be that the baseline be reduced, as there is now a reasonable amount of baseline data collected from both Ferguson's and the present study. Having a variety of intervention phases has been shown to be important in order to implement a behaviour change (Sherer et al., 1984; Collins, 1989; Beaglehole, 1990 & Ludwig & Geller, 1991;), but a fewer number of phases and increasing the length of each phase is strongly recommended.

The Polytechnic did not prove to be as populated with cyclists as was expected. No clear conclusions could be made from cyclists at this location because of the low absolute number of cyclists. Using Polytechnic cyclists again as a target group would need to be looked at carefully in the future. It is possible that the reduction in cost of cars through cheap Japanese imports, has increased the number of students who can afford cars, and has therefore reduced the number of students who use cycling as their main method of transport.

Although the main experimental hypothesis of increasing the number of cyclists using cycle lights at night was not substantiated, a number of the secondary hypotheses were. It appears that cyclists who travel later at night and during most weather conditions appear to be better equipped, than those cyclists who use this method of transport less frequently. While the behavioural intervention was insufficient to bring about any real changes in observable behaviour, it did appear to increase subjects' awareness and knowledge of the dangers involved, and the necessity to wear both head and tail lights. Results from the post intervention questionnaire showed that over half of the 200 cyclists were aware of the intervention at follow-up. After the intervention, a large number of cyclists perceived cycling to be dangerous, and the majority of cyclists felt that reflectors alone are not adequate and that it is important to have both head and tail lights when cycling at night. The number of cyclists expressing these views was higher after the intervention programme than before. One concern was the small number of cyclists who were aware of the legal time during which lights are required, even after the intervention programme. The Road Code (1986) clearly states that a head and a tail light which can be seen from a distance of 100m are required from thirty minutes after sunset. However, a more common lay person's interpretation, which is just as safe, is when the street lights are turned on. The street lights are computer operated and are light dependent. They turn on automatically once the light drops beyond a certain level.

Considerably more cyclists stated that they owned head lights, tail lights, helmets, reflective gear for their bodies and reflective gear for their bikes than was actually observed. There is a strong possibility that a social desirability bias (Weiten, 1989) was in place. Some of those interviewed, may have had a desire to please the people conducting the interviewing, or to create a good impression of themselves by stating they owned the equipment when in fact they did not.

To conclude, the present experiment failed to significantly increase the proportion of cyclists using head and tail lights when cycling at night. The behavioural intervention approach incorporating prompting, incentive, and enforcement did not prove to be successful in resolving this problem in this particular case There however, is large scope for improving the techniques used during this intervention. There is still considerable opportunity for future behavioural modification interventions to be undertaken in this area. The wearing of cycle helmets when cycling has just become a legal requirement. Research into the number of cyclists legally complying with requirement would be a particularly interesting area of focus.

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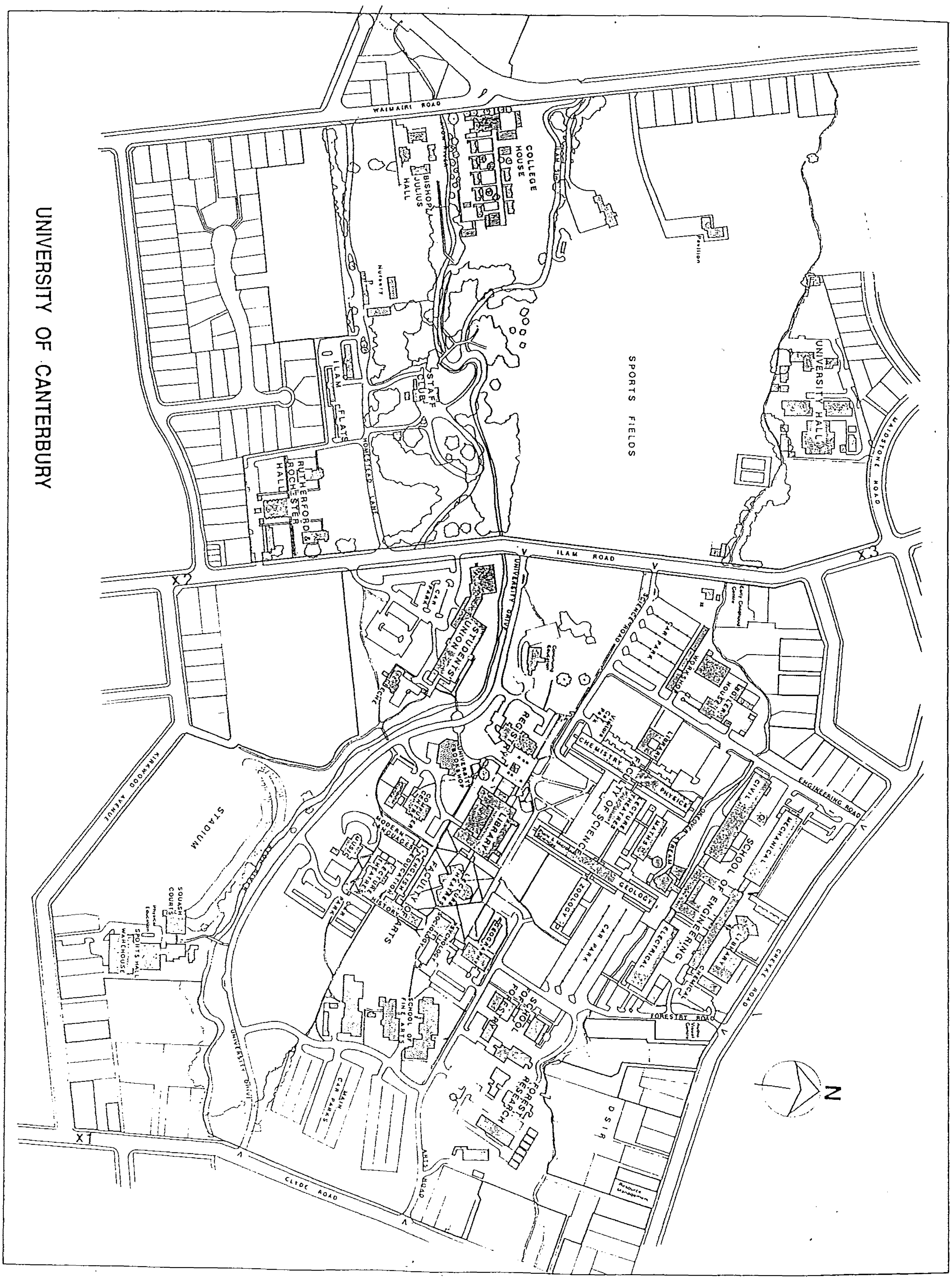
APPENDIX

Appendix A: - Map of University of Canterbury



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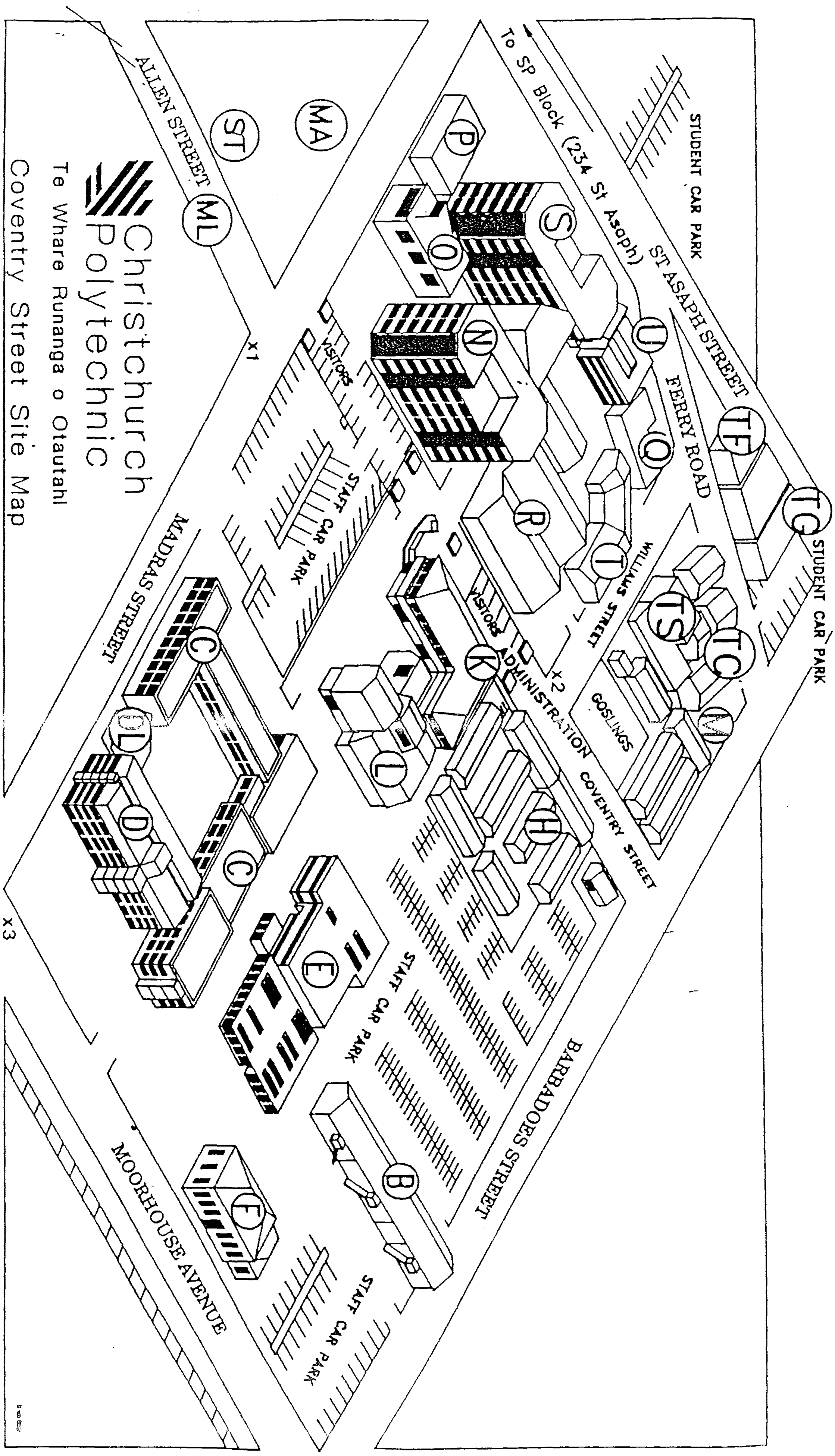
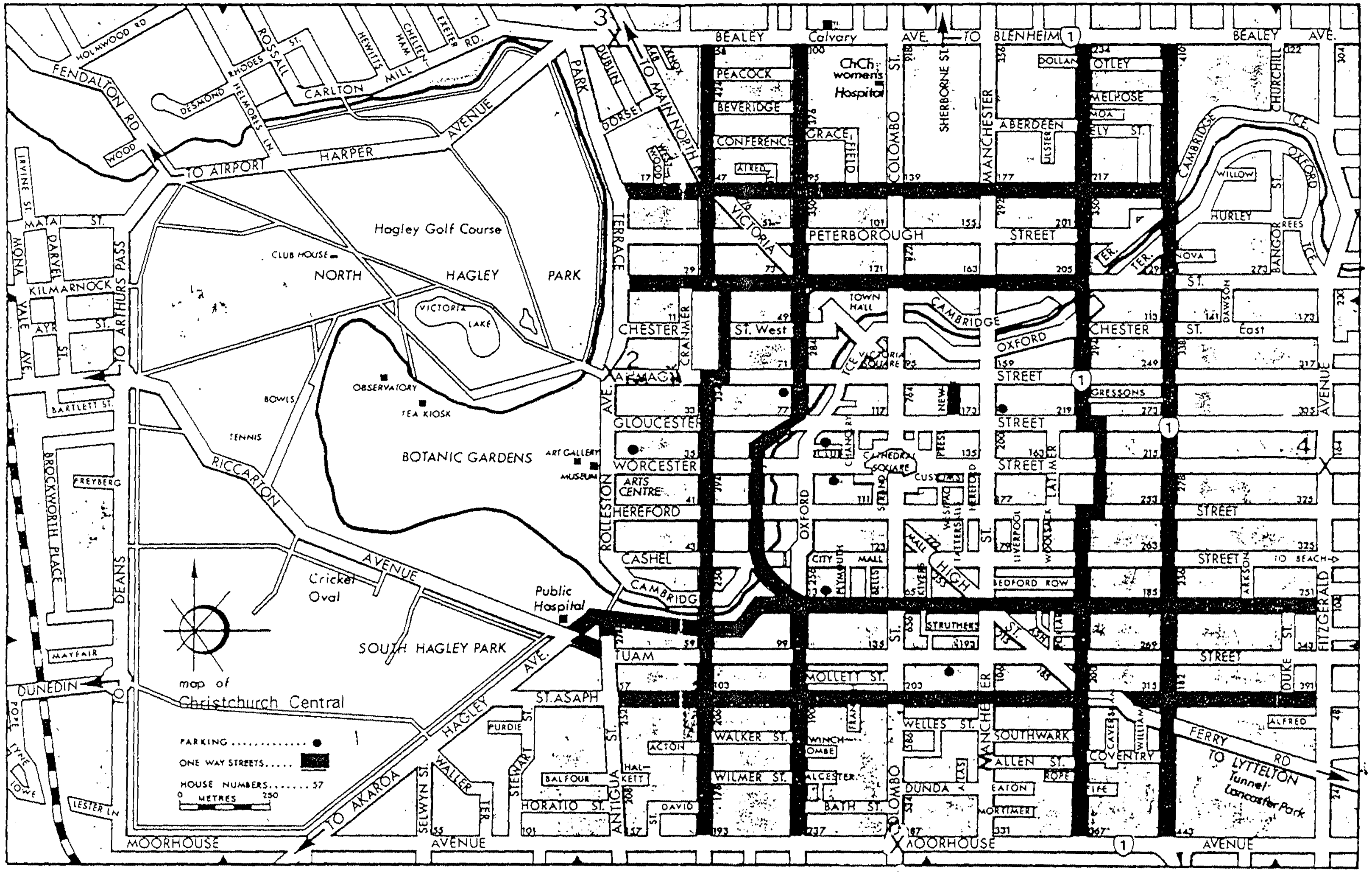
- *Map of Christchuch Polytechnic*



- Map of Christchurch City



Appendix B: - Observation Data Sheet

OBSERVATION DATA SHEET

Name.....................................Date......................Area........

Time lights	Site	Headlight	Taillight	Helmet	Refective Gear e.g.	Street

Appendix C: - Prompting and Incentive Poster

WISE UP, LIGHT UP !!

The bookshop is going to be selling lights, helmets and reflective gear to students from the 10-27th June.

The equipment is being supplied by Craig Adair Cycles, and comes with their life-time guarantee.

Lights from only $9

Reflective gear from only $10

Helmets only $28.95

WIN FREE LIGHTS!!

A competition is going to be run, enabling you to win back the purchase price of your lights.

It will work like this:

-The lights will be ordered from the bookshop

-They will be able to be picked up each Friday, between 12-2pm. (Any problems with this, just let the bookshop know.)

- Write your name, address and phone number on the back of the receipt, and place in the labelled box

-Names will be drawn at the end of each week, and displayed in the bookshop.

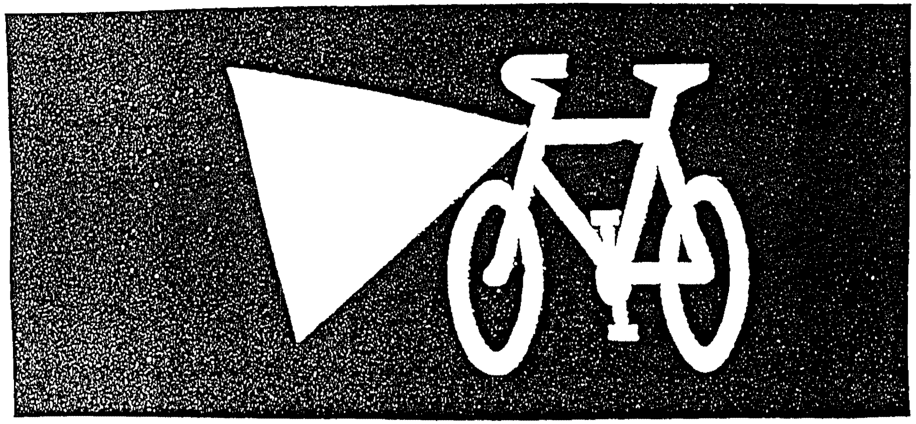
So cyclists, take this opportunity to light up your life!

Whitcoulls

CRAIG ADAIR CYCLES CRAIG ADAIR CYCLES

Appendix D - Educational and Incentive Pamphlet

WISE UP,



LIGHT UP!

Fact:

- By law, your bike must have a head light and tail light visible from 100m.

-Cyclists are the most accident prone of all road users.

-One half of all fatal accidents occur at night.

-Have we got a deal for you!!

WIN FREE LIGHTS!!

Lights from only $9,

Reflective gear from $10

Helmets only $39.95.

Being sold at the University Bookshop from the 17th June.

Lights supplied from Craig Adair Cycles, with their Life Time Guarantee.

See bookshop for full details.

Appendix E: - Article placed in University of Canterbury Student Newspaper

Cycle Safety.

Cycling as a cheap, heathy and convenient means of transport, has increased markedly in recent years. Unfortunately, it has proved to be a very hazardous activity! Cyclists are 55 times more accident prone than motorists, and most of these accidents occur at night or with poor visibility, partly due to our serious winter smog problem. Cyclists are even more at risk on roads than motorcyclists, who are generally regarded as the highest risk group. The injury rate for cyclists is twice as high as that for motorcyclists.

Over one half of all fatal cycle accidents occur at night. Inadequate lights are an important factor in causing 1 in 3 night time cycle accidents in Christchurch. Only one half of Christchurch cyclists have adequate head and tail lights. By law, the Road Code states that at night time, your bicycle must carry a white head light and a red tail light, visible at 100 metres. This does not include lights attached to your body; they are a useful addition to properly fitted head and tail lights, but they are not legal in themselves. Lights should be turned on no later than the street lights.

Obviously, by having adequate cycle lights, many of these accidents are preventable. Head and tail lights are essential, as is a good rear reflector, to alert motorists to your presence. Pedal and spoke reflectors, body lights, and reflective clothing also increase your chances of staying alive on the road. Wearing dark clothing is also considered as a precipitating factor in accidents.

To make it easier for students to purchase lights, the University Bookshop, will be selling lights reflective gear and helmets, from the 17th of June. Lights from $9.00- $19.95 will be supplied by Craig Adair Cyclists. This is a special price Craig has worked out for students, and the lights come with his "Life time Guarantee". Various reflective gear from $10.00 upwards will also be avaliable, as will 'Ace' helmets at $39.95.

A competition is also going to be run, offering students the chance to win back the purchase price of their cycle lights. This will work by you putting your name, address and phone number on the back of the receipt. They will be drawn at the end of the 3 weeks, continuing until $250 has been used up.

So cyclists, take this opportunity to light up your life! It just might save it.

Appendix F: - Statements read on Christchurch Polytechnic Student Radio Station

1. By law, you need to have both a head and tail light when cycling at night. The MOT will be enforcing this. Buy cheap lights at the Ploytech. Whitcoulls bookshop. You could win your money back.

2. Buy cheap bike lights, helmets and reflective gear now at the Ploytech. Whitcoulls bookshop. Win free lights!! See the bookshop for details.

3. Over half of the fatal bike accidents in Christchurch occur at night. You can prevent this by using head and tail lights on your bike. Light up! It's your life. See the Polytech Whitcoull's bookstore for cheap bike lights. You could win your money back.

4. Wise up, light up. Make sure you can be seen on the roads tonight. Fix lights to your bike today. See the Polytech Whitcoull's bookstore for cheap bike lights. You could win your money back.

Appendix G: - Cycle Safety Awareness Evaluation Questionnaire

1. Sex M___ F____

2. Do you have any of the following?:
Cycle Headlight____ Cycle Tail light____ Spoke Reflector___
Cycle Helmet___ Reflective gear, e.g.____________________

3. a) Do you regularly cycle at early evening, or at night?
Y____ N____
b) How far do you typically cycle at this time?_____km

4. Have you heard or seen anything encouraging the use of head or tail lights in the last:
-week?_____
-month?____
How did you hear or see about it?
POSTER, LEAFTET, RADIO AD, ARTICLE, OTHER_________

Can you please tell me how much you agree or disagree with the following statements:

	strongly agree	agree	undecided	disagree	strongly disagree
5. Cycling in Chch is dangerous	______	______	______	______	______
6. Reflectors alone are quite adequate when cycling at night	______	______	______	______	______
7. Safety helmets are a necessary piece of equipment for all cyclists.	______	______	______	______	______
8. It is important to have <u>both</u> head and tail lights when cycling at night.	______	______	______	______	______

9. From what time in the evening are cycle head and tail lights required to be turned on?______

10. Do you plan to buy any of the following safety equipment in the next month?

Head or tail light	____	Body light	____
Reflective clothing	____	Rear red reflector	____
Spoke or pedal reflectors	____	Safety helmet	____

-Post intervention additions to Questionnaire

11. Were you aware of any competition involving cycle lights?
y______ N______

(If yes......a) How did you know about the competition?

Poster
Leaflet
Radio
Newspaper or magazine Article
Other________________________

b) What did you have to do to win?

c) What was the prize?

12. Did you enter the competition? Y_____ N______

Why?

Why not?

Appendix H: - Correlations between meterological variables and measures of cycle light usage at each location.

Table H-1. Correlations between meterological variables and dependent measures at City Centre.

% Cyclists	Sunset	Rainfall	Temperature	Humidity
Total Number	-.17	-.76*	.09	-.44
Early	-.01	-.66	-.20	-.24
Late	-.38	-.58	.34	-.55
Head Lights	-.06	-.13	-.69	.17
Early	.23	-.21	-.77*	.36
Late	.07	-.44	-.38	.30
Tail Lights	-.77*	.36	-.23	-.58
Early	.15	.75*	-.53	.31
Late	.31	-.53	-.06	.03
Both Lights	-.07	-.29	-.23	.31
Early	-.39	.66	-.77*	.12
Late	.17	-.70	.21	.13
Helmets	.19	-.68	-.27	.20
Early	-.01	.28	-.79*	.21
Late	.07	-.43	-.37	.33

Early = 5.00-6.00pm, Late = 6.00-8.30pm * p<.05.

Table H-2. *Correlations between meterological variables and dependent measures at Polytechnic.*

% Cyclists	Sunset	Rainfall	Temperature	Humidity
Total Number	-.03	-.38	.57**	-.29
Early	-.07	-.31	.42	-.44
Late	-.39	-.24	.57*	-.33
Head Lights	.10	.22	.17	.13
Early	-.15	.52*	.17	.10
Late	.13	.14	.15	.06
Tail Lights	.05	.28	.16	.15
Early	-.13	.52*	.17	.10
Late	.07	.06	.21	.14
Both Lights	.36	.31	.04	.18
Early	-.11	.54*	.11	.03
Late	.21	.08	.22	.12
Helmets	.13	.05	.01	.12
Early	.08	-.13	.15	.09
Late	.34	.10	-.36	.15

Early = 5.00-6.00pm, Late = 6.00-8.30pm * p<.05. **p<.01.

Table H-3. *Correlations between meterological variables and dependent measures at University.*

% Cyclists	Sunset	Rainfall	Temperature	Humidity
Total Number	.02	-.70***	.69***	-.57**
Early	.04	-.61**	.60**	-.45*
Late	-.16	-.67**	.51**	-.45*
Head Lights	-.21	.57	-.39	.43*
Early	-.14	.53	-.52**	.44*
Late	.20	.21	.08	.01
Tail Lights	-.41*	.23	-.32	.38
Early	-.19	.38	-.49*	.53
Late	-.25	.05	.06	.06
Both Lights	-.44*	.23	-.29	.28
Early	-.01	.39	-.41*	.40
Late	.10	.03	2.78E-3	-.09
Helmets	-.35	.24	-.07	.06
Early	-.25	.26	-.08	.10
Late	-.19	.02	.01	-.14

Early = 5.00-6.00pm, Late = 6.00-8.30pm * p<.05. **p<.01. ***p<.001.